DIESEL & GAS ENGINE PROGRESS

DIESEL ENGINES • DUAL FUEL ENGINES • NATURAL GAS ENGINES • GAS TURBINES

FIVE DOLLARS PER YEAR

MARCH, 1961

FIFTY CENTS PER COPY

For many years the Transmission and Axle Division of Rockwell-Standard has specialized in the design and production of components that help to assure superior performance for special purpose vehicles. We offer manufacturers a complete design, testing and production service. *And we produce and sell only components, not the complete vehicle!*

The component you think "special"—and highly expensive and time-consuming to build—could well be a standard item in Rockwell-Standard's full line of driving assemblies and planetary axles, Hydra-Drives torque converters and power shift transmissions.

If your needs call for a "custom" job, you can be sure Rockwell-Standard engineers can design it to exact specifications—and build it for less. For complete information about Rockwell-Standard's full line of driving assemblies and planetary axles; Hydra-Drives torque converters and power shift transmissions, plus other components for special purpose vehicles write or call today.

Another Product of...

ROCKWELL-STANDARD
CORPORATION

Transmission and Axle Division, Detroit 32, Michigan

Auxiliary Gas Turbines becoming a prime power source for industry

Helmut Schelp, chief engineer, AiResearch Manufacturing Division of Arizona, Phoenix, surrounded by typical gas turbines now in production ranging in size from 30 to 850 hp. Clockwise from the top: GTC 85-28 GTCP 105 · GTP 70-6 · GTP 30-1 · GTP 70-10 · GTU 85-2.

AiResearch Gas Turbine Engines, the most widely used power source for the starting, air conditioning, cooling and heating of jet aircraft, now are becoming a prime power source for industry.

Easier to maintain because of few moving parts, these lightweight gas turbine engines develop more horsepower per pound of weight and size than any other engine. Achieving their greatest efficiency at maximum speeds, they run on almost any fuel and start immediately in any weather.

Future prime power applications of AiResearch gas turbines for industry: earthmoving equipment; small independent generator plants; marine use; helicopters and small conventional aircraft; emergency power plants; air conditioning, heating and refrigeration; atomic energy; compressor sets and air drilling for gas gathering.

First to design and develop a successful small gas turbine engine, Garrett is the world's largest manufacturer of lightweight turbomachinery – having delivered more than 200,000 units, including 9000 gas turbines of all types ranging from 30 to 850 hp. Through its AiResearch Manufacturing Divisions, The Garrett Corporation is now offering this experience to all industry.

THE GARRETT CORPORATION

AiResearch Manufacturing Divisions

LOS ANGELES 45, CALIFORNIA • PHOENIX, ARIZONA

OTHER DIVISIONS AND SUBSIDIARIES: AIRSUPPLY-AERO ENGINEERING • AIRESEARCH AVIATION SERVICE • GARRETT SUPPLY • AIR CRUISERS AIRESEARCH INDUSTRIAL • GARRETT MANUFACTURING LIMITED • MARWEDEL • GARRETT INTERNATIONAL S.A. • GARRETT (JAPAN) LIMITED

DIESEL AND GAS ENGINE PROGRESS

REX W. WADMAN *Editor and Publisher*

DIESEL ENGINES • DUAL FUEL ENGINES • NATURAL GAS ENGINES • GAS TURBINES

BRUCE W. WADMAN *Executive Vice Pres.*
ROBERT E. SCHULZ *Vice Pres., & Managing Editor*
ANTHONY A. ALBERTE *Associate Editor*
JAMES W. BROWN *Midwest Editor*
ELTON STERRETT *Southwest Editor*
ANNE S. GALARIS *Circulation Manager*

CONTENTS FOR MARCH, 1961

MEMBER OF BPA
Business Publications Audit of Circulation, Inc.

DIESEL AND GAS ENGINE PROGRESS for March, 1961, Vol. XXVII, No. 3. Published Monthly by Diesel Engines, Inc., 1701 W. Wisconsin Ave., Milwaukee 3, Wisc. Phone DIvision 4-5355. Subscription rates are $5.00 for U.S.A. and possessions. All other countries $7.50 per year. Subscriptions may be paid the London Office at £2-12s-6d per year.

DIESEL AND GAS ENGINE PROGRESS is indexed regularly by Engineering Index, Inc. and is available in microfilm editions from University Microfilms, Inc., Ann Arbor, Michigan.

MEMBER OF MPA
Magazine Publishers Association, Inc.

EXECUTIVE OFFICES
9110 Sunset Blvd.
Los Angeles 46, Calif.

EDITORIAL OFFICES
1701 W. Wisconsin Ave.
Milwaukee 3, Wisc.

BUSINESS OFFICES

MILWAUKEE 3:
Bruce W. Wadman
1701 W. Wisconsin Ave.
DIvision 4-5355

LONDON E.C. 4:
G. L. Fetherstonhaugh
St. Paul's Corner
Ludgate Hill
City 5318

FIELD EDITORS

HIALEAH, FLA.:
Edwin Dennis
250 W. 50th St.
TUxedo 8-2188

WALNUT CREEK, CALIF.:
F. Hal Higgins
90 Grand View Place
YEllowstone 4-9531

HOUSTON 18, TEXAS:
Donald M. Taylor
1345 Chamboard Lane
OVerland 6-1127

HOUSTON 6, TEXAS
Elton Sterrett
1948 Lexington
JAckson 2-9088

JEFFERSON CITY, MO.:
L. H. Houck
400 Linden Dr.
Phone: 6-2993

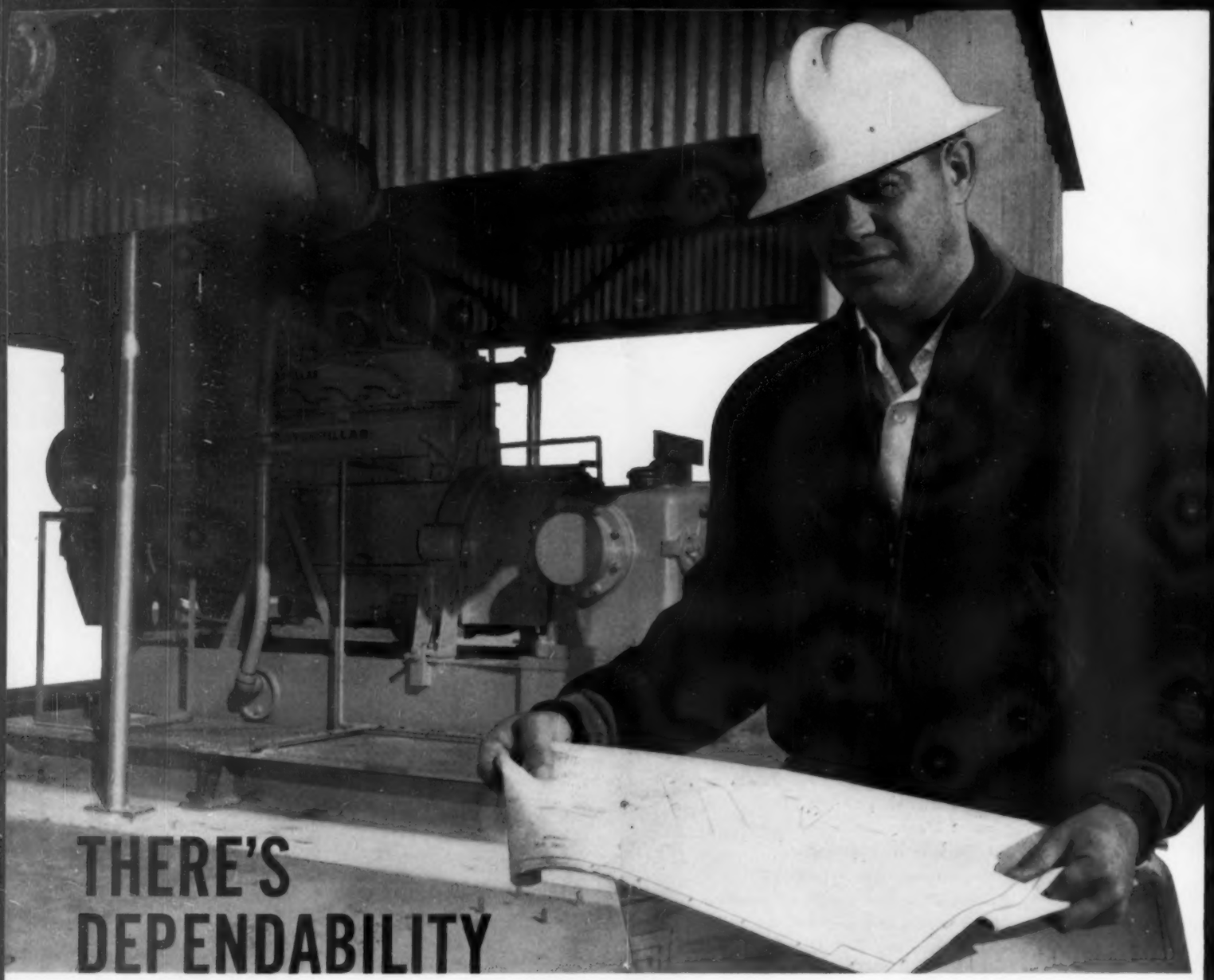
LOS ANGELES 46:
James Joseph
8421 Melrose Ave.
OLive 3-4542

DETROIT 39, MICH.:
James W. Brown
15936 Kinloch Road
KEnwood 2-1545

EVANSVILLE, IND.:
A. D. Burroughs
20 N. Frederick Ave.
Greenleaf 7-0459

FRONT COVER ILLUSTRATION

Two MU-60 units with 12,000 kw capacity are now in peaking service operation at Reno, Nev., for Sierre Pacific Power Co. Units were built by GM's Electro-Motive Division.



THERE'S DEPENDABILITY IN THE RIGHT COMBINATION

engine power BY CATERPILLAR

CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

CAT-POWERED CLARK NATURAL GAS COMPRESSOR

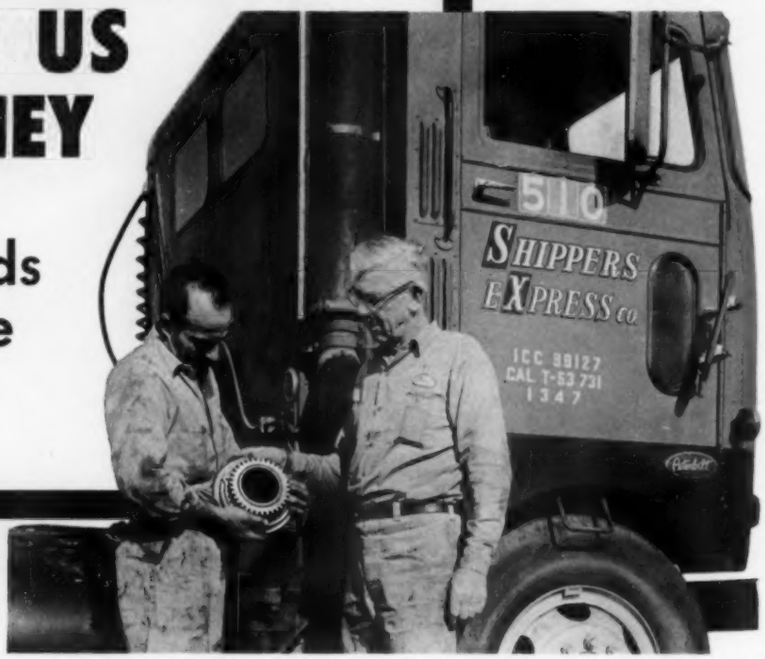
The right combination of engine and driven machine is vital to dependable, profitable operation. Gulf Oil Corporation knows this well. They bought Clark Bros. CFA-2 compressors powered by Cat Natural Gas Engines for gas lift stations in Texas. For installations running 'round the clock, year in and year out, the long life and unmatched fuel economy of Cat Natural Gas Engines really pay off.

Performance like this gives customers confidence in the dealer who recommends Cat Engine power—either diesel or natural gas—on the original equipment he sells. They know that the combination of a quality engine and a quality machine means less downtime, reliable parts and service availability and high trade-in value.

Cat Engines are available on an impressive list of new equipment—trucks, draglines up to 9 cu. yd., crushers, locomotives to 100 ton capacity, drill rigs, workboats, asphalt plants, compressors, road rollers, yachts and other pleasure craft, to name just a few.

For further information about the full line of Cat Diesel and Natural Gas Engines for original equipment write to Engine Division, Dept. 516, Caterpillar Tractor Co., Peoria, Ill. Diesels range from 50—950 HP and natural gas engines are available from 210—560 HP.

"SPICER COMPONENTS SAVE US MONEY ...Our Records Prove It!"



C. W. McClurg, right, maintenance superintendent at Montebello terminal, shows mechanic Fred Curtiss that range synchronizer and clutch gear from Spicer 12-speed transmission is in perfect condition after 160,000 miles of service.

"We specify Spicer components," says C. W. McClurg of Shippers Express Co., Montebello, California, "because our experience, our maintenance records prove they're the most rugged, the most trouble-free we've ever used!

"We specify Spicer components in our new trucks, and we insist on Spicer replacement parts. We know Spicer has helped keep our road failures 'way down! And, believe me, we keep records that show right to the penny what our operating costs are. We stick to *rigid* preventive maintenance schedules.

"Another reason we specify Spicer—the availability of replacement parts everywhere we operate. From San Diego to Los Angeles to San Francisco Bay area to Sacramento—our rigs operate day and night, many of them over mountains with grades of 6 percent, and everywhere we go we know we can get Spicer parts. This is one of the best ways we know to cut down-time.

"We specify every Spicer component we can possibly use—14 inch 2-plate clutches, 12-speed, 5-speed and 4-speed transmissions, 3-speed auxiliary transmissions, 1700-series universal joints and propeller shafts. And our maintenance records show Spicer prop shaft assemblies give us up to 400,000 miles before rebuilding is necessary. We get up to 300,000 miles on Spicer clutches before rebuilding, and the gears in Spicer transmissions generally last about 500,000 miles.

"The use of Spicer components fits in ideally with our cost-saving maintenance program. I base this statement on my 25 years' experience in the trucking business."

About Shippers Express Company . . .

"We operate 210 pieces of equipment," says Mr. McClurg. "This includes 17 three-axle rigs in our long-line equipment, 13 three-axle heavy duty trucks for local dispatching, 10 two-axle cab-overs, and 40 two-axle tractors for local deliveries.

"Shippers Express Company was founded in 1926 by A. D. Woolley, who is now chairman of the board. C. R. Hart is president and R. E. Woolley is vice-president and general manager. Our home office is in San Jose, California."

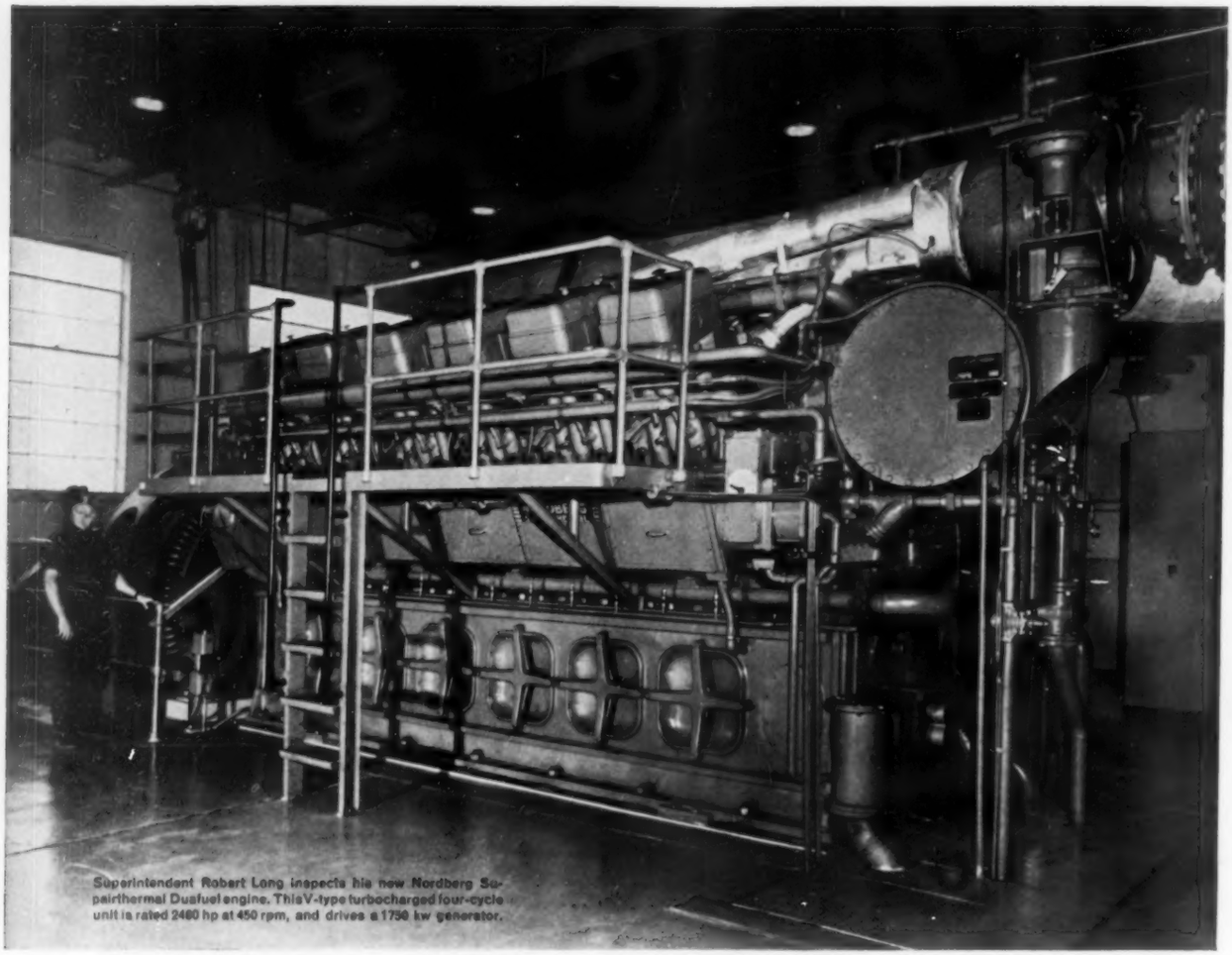
SPECIFY SPICER components for trouble-free operation, low maintenance cost, availability of replacement parts. For information on Spicer products write Dana Corporation, Toledo 1, Ohio.

DANA Spicer

DANA CORPORATION

SERVING TRANSPORTATION—Transmissions • Auxiliaries • Universal Joints • Clutches • Propeller Shafts • Power Take-Offs • Torque Converters • Axles • Powr-Lok Differentials • Gear Boxes • Forgings • Stampings • Frames • Railway Drives

Many of these products are manufactured in Canada by Hayes Steel Products Limited, Merritton, Ontario Toledo 1, Ohio



Superintendent Robert Long inspects his new Nordberg Supairthermal Duafuel engine. This V-type turbocharged four-cycle unit is rated 2460 hp at 450 rpm, and drives a 1750 kw generator.

NORDBERG DUAFUEL ENGINE
takes on 20% of load—saves over $1,700.00
in one month's operation at Quakertown, Pennsylvania

A new engine is leading the steam-diesel team at the Quakertown, Pennsylvania, Municipal Electric Plant to the best production economy in the plant's long history. The engine is a Nordberg Supairthermal Duafuel unit rated 2,460 hp at 450 rpm.

Purchased originally to supplement other generating equipment during high-load periods or emergencies, the new Nordberg is now producing over 20% of the entire plant output.

Although still considered to be in its initial period of break-in and adjustment, the engine showed in one month how much can be expected of it. Running on a combination of natural gas and diesel pilot oil, the engine produced 417,873 kilowatt-hours, at a cost of only 5.31 mills per kwh. Based on an annual overall plant cost of 8.397 mills per kwh, the Nordberg Supairthermal engine, handling 20.7% of the load, showed a saving of some 10%, representing over $1,700 on the fuel bill for a single month.

Savings like this reaffirm Borough Management's belief in diesel power as the best means to keep up with Quakertown's growing demand for electricity. Significantly, the engine was installed in a new building large enough to house two additional units . . . another indication that Quakertown is already planning for the future.

NORDBERG MANUFACTURING COMPANY • Milwaukee 1, Wisconsin

ATLANTA • CLEVELAND • DALLAS • DULUTH • HOUSTON • KANSAS CITY • MINNEAPOLIS • NEW ORLEANS • NEW YORK • ST. LOUIS
SAN FRANCISCO • TAMPA • WASHINGTON • WICHITA, KAN. • TORONTO • VANCOUVER • JOHANNESBURG • LONDON • MEXICO, D. F.

4311

CFC MODELS AND MEDIA TO MEET YOUR FILTRATION NEEDS

The standard line of CFC filtration equipment includes over 4311 different models and media. And if one of these isn't ideal for your application, CFC will engineer a filter to your exact needs.

CFC filters all types of industrial fluids — from Air to Zinc Cyanide — from 1 gallon per hour to 2700 gallons per minute. The complete line includes **FULFLO** Filters with media made from a wide variety of natural or synthetic fibres, resin-impregnated paper, sintered or woven metals and porous ceramics for precise filtration of liquids and gases; **HONAN-CRANE** Filters with fibre, resin-impregnated paper or adsorptive earth media for industrial oils; **DELPARK** Continuous Filters for cutting oils, coolants and other industrial liquids.

Look to CFC Filters — to improve product quality, cut maintenance and production costs, protect valuable equipment and reduce costly down time. Write for catalog or engineering assistance to Dep't

CFC

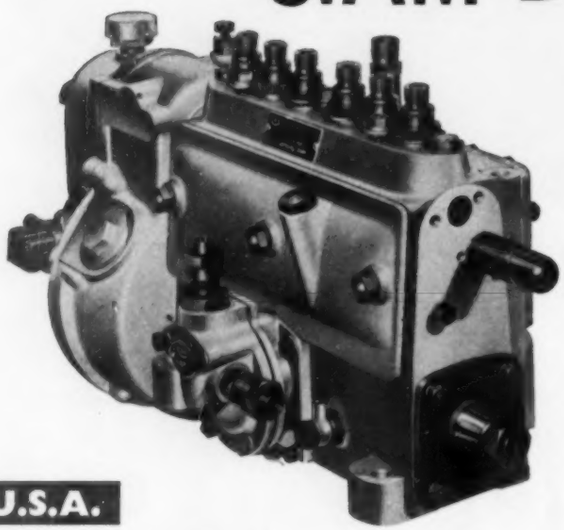
COMMERCIAL FILTERS CORPORATION

Fulflo Honan-Crane Delpark Michiana

MELROSE 76, MASSACHUSETTS

PLANTS IN MELROSE, MASSACHUSETTS AND LEBANON, INDIANA

C.A.V. DIESEL SERVICE SPECIALISTS IN U.S.A. AND CANADA



U.S.A.

ALABAMA
Birmingham
Mobile

ARIZONA
Phoenix

ARKANSAS
De Witt
North Little Rock

CALIFORNIA
Bakersfield
El Centro
El Monte
Fresno
Long Beach
Los Angeles
San Diego
San Francisco
Wilmington

COLORADO
Denver

DELAWARE
Milton

FLORIDA
Jacksonville
Orlando
Miami
Tampa

GEORGIA
Atlanta

IDAHO
Pocatello
Twin Falls

ILLINOIS
Chicago

INDIANA
Indianapolis

IOWA
Des Moines

KANSAS
Colby
Garden City
Great Bend
Grinnell
Hutchinson
Plainville
Salina
Wichita

KENTUCKY
Louisville

LOUISIANA
Baton Rouge
Lake Charles
Morgan City
New Iberia
New Orleans
Shreveport

MARYLAND
Baltimore

MASSACHUSETTS
Boston
Springfield

MICHIGAN
Detroit
Grand Rapids
Ishpeming
Lansing

MINNESOTA
Hibbing
Minneapolis

MISSISSIPPI
Jackson
Meridian

MISSOURI
Kansas City
St. Louis

NEBRASKA
Gordon
Lincoln
McCook
North Platte
Omaha

NEW MEXICO
Albuquerque

NEW YORK
Buffalo
Broooklyn
Long Island
New York

NORTH CAROLINA
Charlotte
Raleigh

NORTH DAKOTA
Fargo
Minot

OHIO
Akron
Cincinnati
Cleveland
Dover
Toledo

OKLAHOMA
Enid
Oklahoma City
Ponca City

OREGON
Portland

PENNSYLVANIA
Philadelphia
Pittsburgh

SOUTH DAKOTA
Winner

TENNESSEE
Chattanooga
Knoxville
Memphis
Nashville

TEXAS
Amarillo
Beaumont
Corpus Christi
Dallas
Houston
Odessa
San Antonio

UTAH
Salt Lake City

VIRGINIA
Norfolk
Richmond
Salem

WASHINGTON
Seattle
Spokane

WISCONSIN
Milwaukee
Sun Prairie

CANADA

ALBERTA
Calgary
Edmonton
Lethbridge
Medicine Hat

BRITISH COLUMBIA
Vancouver

MANITOBA
Winnipeg

NEW BRUNSWICK
Fredericton

NOVA SCOTIA
Halifax
Liverpool

ONTARIO
Brockville
Cornwall
London
Ottawa
Pembroke
Sudbury
Toronto
Thornhill

QUEBEC
Montreal
Quebec

SASKATCHEWAN
Regina
Saskatoon

The World's Largest Manufacturers of

FUEL INJECTION EQUIPMENT

C.A.V.

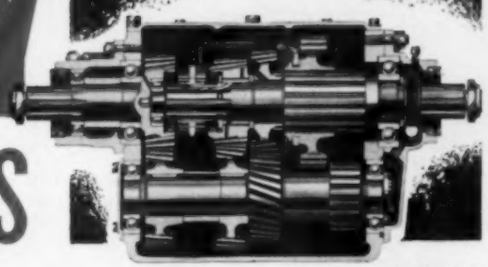
For full list of Service Agents write to:
Fuel Injection Equipment Division of
LUCAS ELECTRICAL SERVICES, INC.
Head Office: New York, N.Y.
Sales Office: Cleveland, Ohio
Factory Branches: Los Angeles, San Francisco, Seattle, Denver, Chicago, Houston, Jacksonville, Boston, Baltimore
JOSEPH LUCAS (CANADA) LTD.
Head Office: Toronto
Factory Branch: Montreal

AP 130

NEW 4-SPEED AUXILIARY TRANSMISSIONS

For Medium-Heavy Duty Trucks and Tractors

MODELS 4-B-73 AND 4-B-75



SPLIT GEARS AND *GO*... SHIFT INTO DEEP REDUCTIONS AND *PULL*

You no longer have to pay a premium price for a 4-speed auxiliary which is heavier than your operation demands. Save weight *and* money with one of the new Fuller 4-speed Auxiliaries equipped with overdrive, direct, low and low-low gear ratios in one compact, 375-pound unit. Get gear-splitting ratios plus deep reduction.

The Fuller 4-B-73 is designed for use with engines producing approximately 500-600 lb./ft. of torque. Use of special high-capacity bearings permits the 4-B-75 to be used with engines in the 600-700 lb./ft. torque class.

Get all the extras of price, performance and payload. Specify the new Fuller 4-B-73 or 4-B-75 4-speed Auxiliary Transmissions. For full details, see your truck dealer or write Fuller Manufacturing Company.

GEAR RATIOS
Models 4-B-73 and 4-B-75

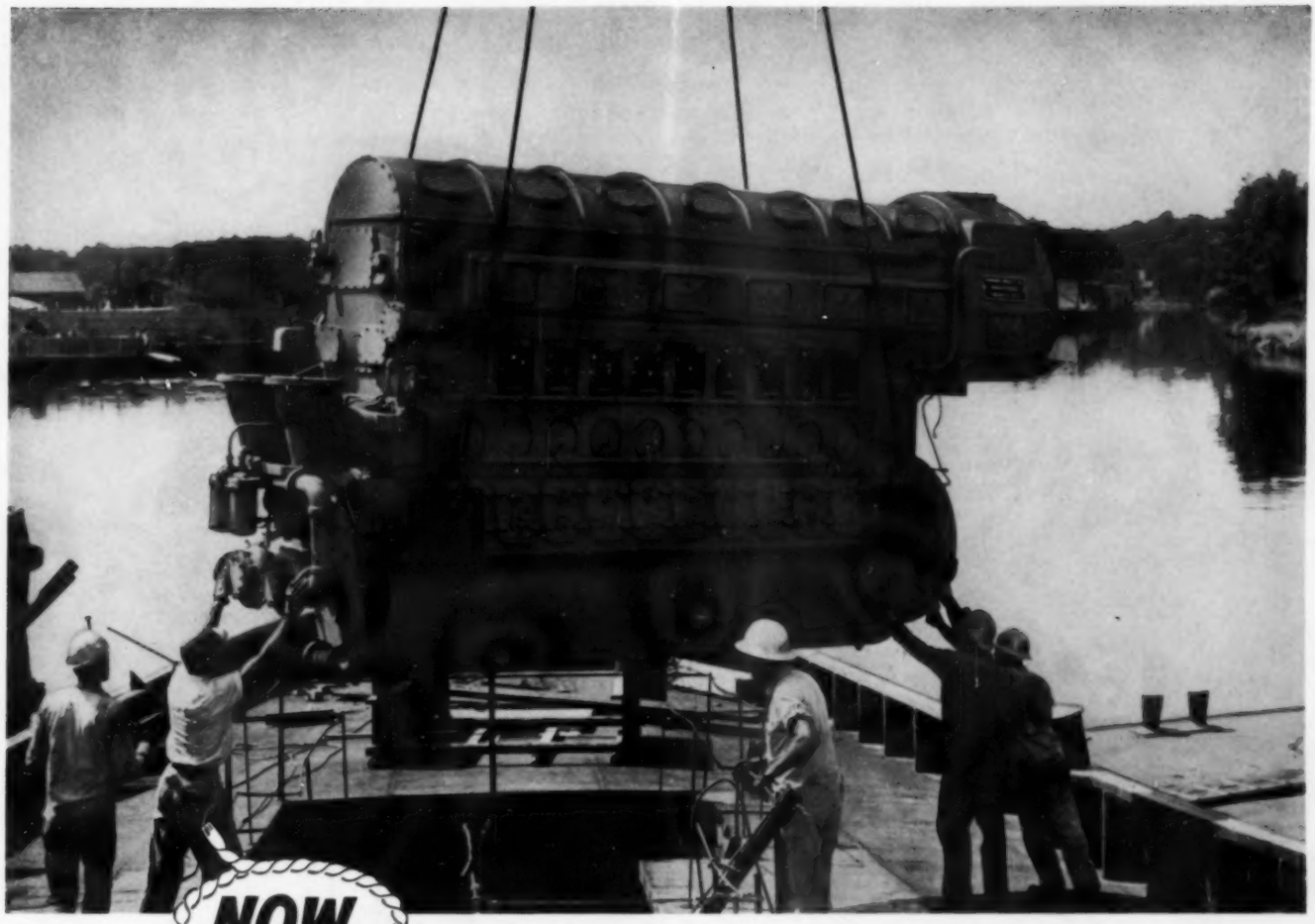
Overdrive	.85
Direct	1.00
Low	1.24
Low-Low	2.22

FULLER TRANSMISSION DIVISION

EATON MANUFACTURING COMPANY

KALAMAZOO, MICHIGAN

Sales & Service: West. Dist. Branch, Oakland 6, Cal. • Southwest Dist. Office, Tulsa 3, Okla. • Automotive Products Co., Ltd., Brock House, Langham St., London W.1, England, European Rep.



NOW... MORE POWER AFLOAT...

LESS SPACE IN YOUR BOAT!

F-M OPPOSED PISTON MARINE DIESELS

F-M's exclusive O-P (Opposed Piston) Marine Diesels set the standard for dependability through years of grueling service in all maritime operations! They provide more power afloat . . . take up less space in the boat! *You* can haul more cargo!

Compact and powerful, O-P Marine Diesels give *more* horsepower per pound than any other comparable type of engine. Opposed Piston design, a Fairbanks-Morse exclusive, is responsible. Two pistons in one cylinder function from a single combustion. Result... power when you need it . . . power you can depend on! Economical power!

Fairbanks-Morse O-P Marine Diesels save you money too. 40% fewer wearing parts than comparable engines saves on maintenance and shutdowns, due to repair.

F-M Opposed-Piston Marine Diesels are available in direct-reversing or non-reversing models . . . turbo-charged if desired. HPs from 640 to 3600 normally aspirated or turbo-super-charged. Available in 4, 5, 6, 8, 10, 12 cylinder models.

For further information and specifications, write: **Mr. S. K. Howard; Fairbanks, Morse & Co.; Diesel Division; Beloit, Wisconsin.**

F-M O-P MARINE DIESELS PASS RIGID NAVY SPECIFICATIONS!

One of 7 tugs built for port duty by Southern Shipbuilding, the husky YTB 757 will maneuver naval aircraft carriers and ships into dock. Besides its F-M 10 cylinder 38D8 1/8 O-P Marine Diesel, it is equipped with a Lufkin Reverse Reduction Gear to provide precision maneuvering with pilot-house control.

FAIRBANKS MORSE

A MAJOR INDUSTRIAL COMPONENT OF

FAIRBANKS WHITNEY

THESE GOOD DIESELS DEPEND ON HMS ROOSA MASTER

In less than 10 years more than 250,000 Roosa Master fuel injection pumps will have served as the heart of these famous diesels. Problems of engine manufacturers have been our greatest asset. Solution of these have led to greater simplicity, greater versatility and increased engine efficiency. Tomorrow's Roosa Master pump will be even more compact, more economical and more versatile. Let our research team help you *before* you design your next diesel. Hartford Machine Screw Company, Division of Standard Screw Company, Hartford 2, Connecticut.

Member

make your good diesel better with HMS ROOSA MASTER

DYNAMIC DIESEL DRIVES

with Rockford Spring-Loaded Clutches

Get maximum power from your diesel engines with Rockford Clutches. Cut costs of downtime, replacement and labor. Up to 1/32" more facing thickness gives extra long clutch life. Minimum inertias prevent gear clashing and delayed shifting. Rockford's vibration-free clutches offer smoother engagements through dynamic and static balancing. Rotary surface grinding assures uniform thickness of clutch components. Quality construction is Rockford's key to rugged clutch service. Rockford Clutch offers an ultra-wide range of power controls for all industries. Write today for illustrated brochure.

ROCKFORD CLUTCH

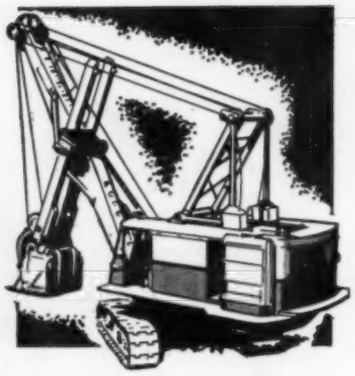
1321 EIGHTEENTH AVE. ROCKFORD, ILLINOIS

Export Sales Borg-Warner International · 36 So. Wabash, Chicago, Ill.

BW DIVISION OF BORG-WARNER

Question for crane and excavator owners:

Is torque converter drive "better" or only "different"?



When you buy an engine, you're actually buying "horsepower." To deliver the horsepower you paid for, the engine has to operate at or near its governed speed. Every time the engine lugs down under load, it's like money out of your pocket, because you're being *robbed* of horsepower.

In excavator work, particularly in back-hoe and shovel digging, the operator works more or less "by ear," depending on engine noise to find the best bite. This requires careful crowd control to keep from killing the engine. The deeper the bite, the more the engine lugs—with a sacrifice of digging power. The fixed gear ratio in a mechanical shovel drive cannot prevent this power loss.

Keeping this fact in mind, let's take a look at a shovel operation using straight mechanical drive. As the shovel bites in, the load reduces machinery rpm and the engine lugs down. So the operator moves his crowd control trying to find a better bite that will let the engine regain its governed speed. By now, input torque may have already dropped along with rpms. So again the engine lugs as it shoulders the new load—setting up shocks and vibrations throughout the drive train, as well as giving the operator a "workout" which may be repeated hundreds of times a day. From a dollars-and-cents point of view, it's plain inefficient.

Cut-Depth Guesswork Gone

Now let's take the same job and put a torque converter behind the engine. As before, when the cut gets deep, the dipper will slow down, but the engine does *not* lug down. The dipper becomes filled in a shorter distance at little or no increase in filling time. The operator can dig deeper faster because he uses the horsepower advantage gained from an engine running at near constant speed, delivering more horsepower—through the torque converter—to the deck machinery.

It's all done automatically by the torque converter's unique ability to increase engine torque output in the exact ratio demanded by the load. By eliminating engine lugging, the converter gets more work done faster.

"Force without motion" is another advantage of torque converter drive. In crane erection work, any size load can be lifted "on the throttle" and held in mid-air without swaying. This ability to inch and hold under power makes for safety and accuracy in spotting.

Where Did the "Snap" Go?

Ever hear an operator complain that a converter-equipped machine lacked "snap"? He's right as rain, but it's no cause for complaint. The "snap" he's accustomed to is the impact energy caused by quick drum speed change, a common occurrence with mechanical drive. Any sudden load increase imposes terrific shocks on the power train as moving parts are caught in an unyielding steel-clad grip. The resulting stress may be *ten* times that of normal operation. Most machinery downtime can be directly traced to these shock loads.

In a torque converter there's no metal-to-metal connection between driving and driven equipment. The hydraulic fluid has the magic power to soak up shocks and jolts . . . they cannot pass through the converter, either from engine to deck machinery or vice versa. Cable life is doubled and often tripled as a result of this smooth output power.

Profit is the Pay-off

Torque converters pay off across the board. They increase machine average power loading as well as work output per hour. They eliminate the shock loads that lead to high maintenance costs. And they're a real time and equipment saver when it comes to training new operators.

If you're planning to purchase a new machine or repower an old one, torque converter drive will guarantee a bigger return on your investment dollar. Ask your dealer for a demonstration, and be sure to specify Twin Disc — first and foremost name in torque converters. Twin Disc Converters — single-stage or three-stage from 30 to 1000 horsepower — are standard or optional equipment on every make of crane and shovel.

TWIN DISC

TWIN DISC

Torque Converters

TWIN DISC CLUTCH COMPANY

RACINE, WISCONSIN

HYDRAULIC DIVISION, Rockford, Illinois

WASHINGTON MEETING HIGHLIGHTS GAS TURBINE PROGRESS

J. W. Sawyer

THE stage is now set for the Sixth Annual ASME Gas Turbine Conference and Exhibit. Scheduled in Washington, D. C. from March 5 to 9 at the Shoreham Hotel, this year's meeting takes added importance since it is co-sponsored by the United States Department of Defense. This, coupled with the many new developments and applications to be presented, gives the meeting a high level of interest that should attract all segments of the industry.

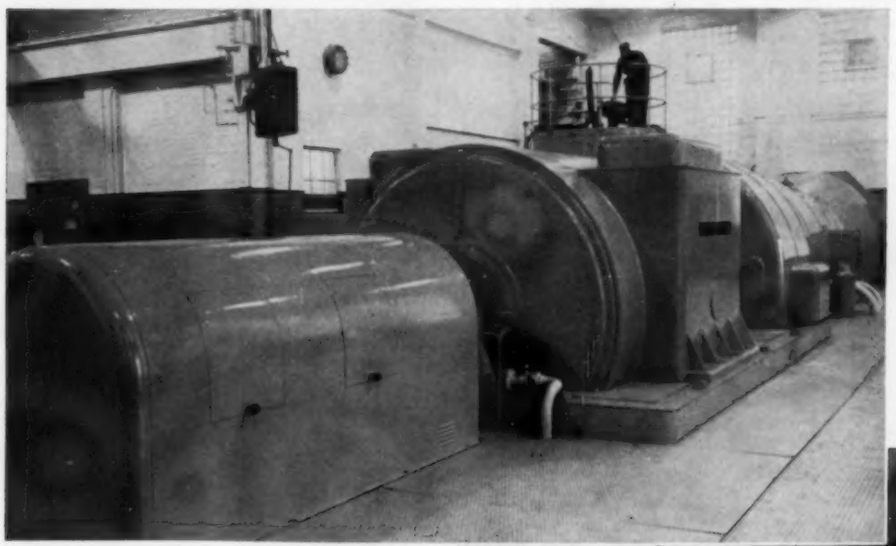
Chairman of the Gas Turbine Power Division for 1961 is J. W. Sawyer of the Bureau of Ships, Navy Department. Here are his comments which summarize the scope and importance of the forthcoming meeting: "Returning to Washington for this Sixth Annual Meeting, we feel this conference is unique in that the Department of Defense is acting as co-sponsors. It will include four days of excellent technical papers, many indoor exhibits, plus outdoor displays of operating equipment and heavy machinery. These outdoor exhibits will be located at the Pentagon and shuttle buses will provide transportation between the hotel and this area. Some 22 papers will be presented during the eight technical sessions we have scheduled encompassing such subjects as: turbine and compressor developments; gas-cooled reactor plants; material research; peaking plants; combined cycles; Army, Navy and Air Force programs; operating experience; and new industrial applications. The broad scope of these technical papers and the range of product displays will provide both the manufacturer and user with much valuable material. In addition it offers these people the opportunity to discuss subjects of mutual interest."

List of exhibitors to date shows 27 manufacturers including most of the major domestic and overseas turbine builders. Here in this Special Gas Turbine Progress Report is a look at what these turbine manufacturer's displays will be featuring:

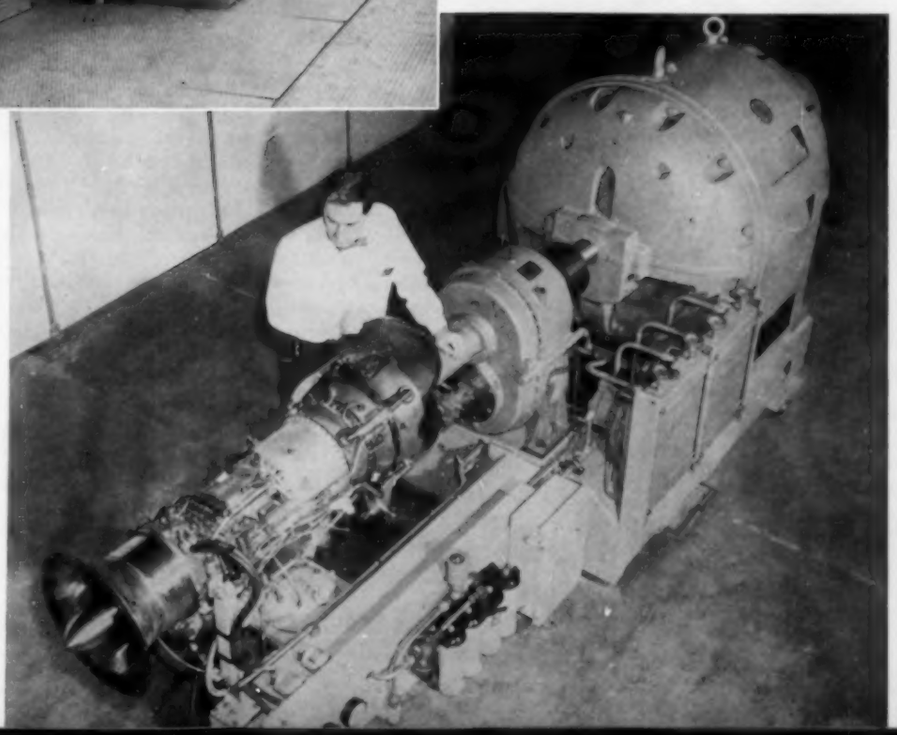
Allison Division, General Motors—Allison will feature its GMT-305 Whirlfire vehicular-type gas turbine engine, and the T63-A-3 turbo-shaft power plant for light rotating wing aircraft. Highlighting the "305," it is a 225 hp unit which is currently being tested in trucks, boats and military vehicles. The Whirlfire is air-cooled, operates on a wide variety of fuels, and employs rotating, self-cleaning regenerators which are stated to be 90 per cent effective in recovering waste heat.

Brown-Boveri—Represented by Z. Stanley Stys, Albert Bertschmann, Robert Steer and T. E. Lucier, Brown-Boveri is bringing a gas turbine rotor from Venezuela for display. This rotor was used in one of two 1650 kw turbines installed in 1949 at the Pertigalete Cement Works. This rotor operated well over 18,000 hrs. in these machines that were fueled with a residual oil high in ash, vanadium, and sodium content. Also featured at the exhibit will be photographs and descriptions of Brown-Boveri gas turbine installations of various types.

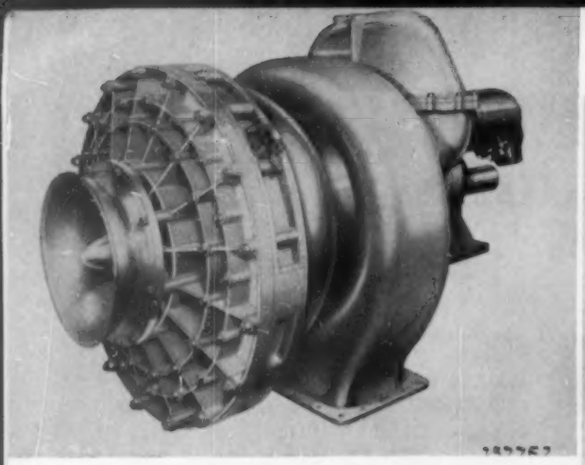
Cooper-Bessemer—The C-B exhibit will highlight application of the firm's jet gas turbine concept. Prominent in their display will be photos of the 10,500 hp RT-248 gas turbine of freepower design put into operation driving a model RF2B-30 gas compressor at Clementsville, (Ky.) recently, and artists' illustrations of jet gas turbine models for power generation and gas compression service. Cooper-Bessemer model features which are substantially different from conventional industrial gas turbines will be emphasized and a model will illustrate "package" arrangement of the jet turbine configuration.



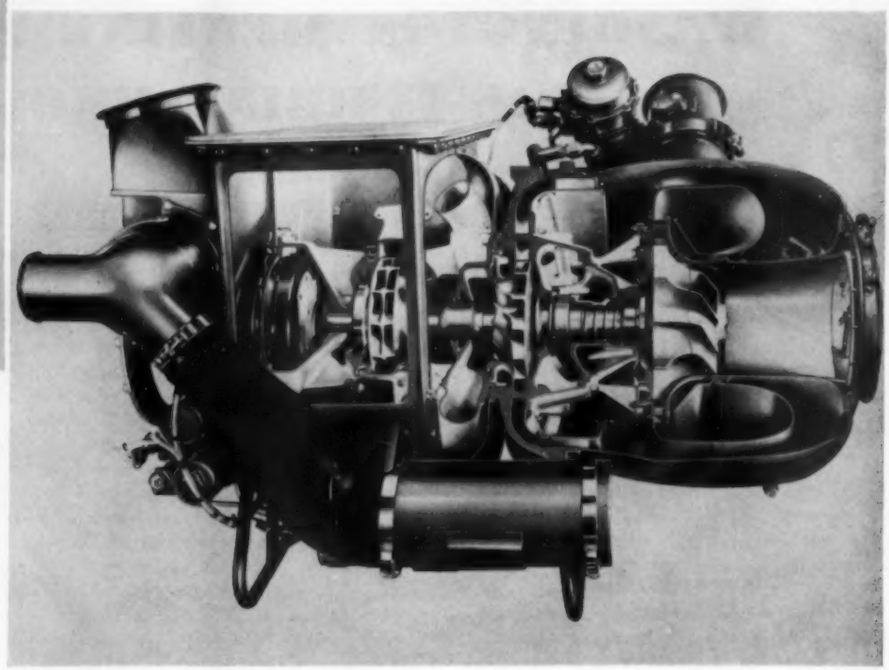
Brown Boveri single shaft gas turbine installed for stand-by and peaking service at the municipal power plant at Moorhead, Minn. Unit operates at 3600 rpm, has a nameplate rating of 7400 kw and output of 9400 kw at 0° F. Maximum output of the generator is 10,000 kw.



General Electric's model 720 packaged turbine-generator set prior to shipment to the Pacific Telephone & Telegraph Co. in Oakland, Calif. This unit will be installed on the roof of the utility's exchange building to supply 750 kw of stand-by electrical power.



Waukesha Motor's new 400 hp gas turbine for vehicular, stationary and marine applications. Development and testing was done in collaboration with the Williams Research Corp.



Cut-away model of the new AiResearch small commercial gas turbine that will be exhibited at the Washington meeting. Turbine is rated 170 eshp at 40,800 rpm. It is of the open cycle type without regenerator.

Clark Bros.—In their exhibit, Clark Bros. will feature its heavy-duty series 300 gas turbines which are built in both single and two-shaft units for driving centrifugal compressors, generators and pumps. Models in this series range to 10,000 hp. Clark Bros. will also focus attention on its contract to design a closed cycle nitrogen turbine-compressor set for use in the first nuclear power plant of this type. This prototype power plant is designed to generate approximately 400 kw, and operate at least one year at full power without refueling. Extremely compact, it must be light enough for air transportation.

Ford—Represented by C. L. Bouchard and I. W. Swatman, Ford Motor Co. will exhibit its 704 gas turbine, a unit that delivers 300 hp at 100° F. This essentially is the second version of the Ford turbine with a more complex cycle. It consists of two stages of compression resulting in an overall pressure ratio of 16:1 with air-to-air intercooling between stages. The 704 is currently being installed in a C-1100 heavy duty truck for test track and over-the-road evaluation.

AiResearch Mfg. Co. of Arizona—This division of The Garrett Corp. will exhibit a number of the models in its line with particular emphasis on the new GTCP 85-91 small commercial gas turbine. This new AiResearch machine is a two-stage unit rated 170 eshp at 100° F., 40,800 rpm. Power-to-weight ratio is .78 hp/lb. Installation of a pair of these turbines is now being completed in an 80 ton hydrofoil for MARAD. Units will be used for starting main propulsion turbine, and supplying vessel's electrical power. It is also anticipated that AiResearch will display one of its new ground support pods, and its new test stand for commercial air turbine starters.

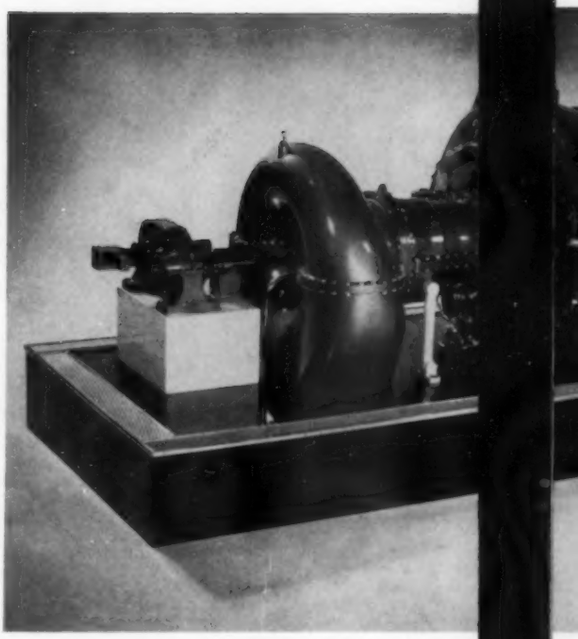
General Electric—This company will be represented with its complete line of gas turbines ranging from 600 to over 35,000 hp for a wide range of stationary, marine, mobile and vehicular applications. Attention will be directed to GE's new model 720/722 turbine produced at the Lynn, Mass. works. And it is anticipated that a mock-up of a 720 turbine with reduction gear for oil field fracturing, or the 720 packaged compressor for gas gathering will be exhibited.

Lycoming—Avco Corporation's Lycoming Division is now in full production on the T53 and T55 series of 1000-2200 hp gas turbines. More than 600 of these engines are already in field use in all climatic conditions. Time between overhauls for the T53-L-1 has recently been increased to 500 hrs. These turbine engines will be marketed for ground and marine use and new models will be on display in the Lycoming booth along with full information on the entire range of engines currently available. Mr. Kenneth Austin will be in charge of the Lycoming exhibit.

Pratt & Whitney—Located next to the Cooper-Bessemer booth, Pratt & Whitney plans to display its 550 hp PT-6 and 2500 hp JT-12 turbine engines, plus a quarter-scale model of its J-57 engine. The J-57 is the 10,500 hp unit which in its first industrial application is driving a Cooper-Bessemer power turbine in gas compressor service on Columbia Gulf pipe line.

Orenda Engines, Ltd.—A. E. Caswell of Orenda's Toronto office will be among the representatives of this Canadian firm at the meeting. Their exhibit will feature a 1/5th scale model of the OT-C-2 series industrial gas turbine which, without recuperator, is rated 6700 hp. Attention will also be centered on the CT-103 axial flow compressor, a 12-stage unit for high efficiency, heavy-duty operation that delivers a compression ratio of 6.5:1 at a mass flow of 67,400 scfm. It is also possible that Orenda may show a model of its 1380 shp OT-C-5 industrial turbine engine.

Solar—Solar's static indoor exhibit will feature actual models of the Saturn 1100 hp and Titan 80 hp gas turbine engines. Particular attention will be devoted to the new applications of the Saturn engine during the past year, both industrial and military, as well as new auxiliary power units utilizing the Titan turbine. The Saturn went into production this year and is being delivered for a variety of applications. It will also soon be installed as a propulsion unit in both Navy and Coast Guard boats and the Army's land train.



Here is the one-fifth scale model of the OT-C-2 gas turbine which Orenda will display. This turbine engine is rated nominally at 6700 hp.

Waukesha—A new turbine will be exhibited by Waukesha Motor Co. Design, assembly and testing of the turbine was done in collaboration with the

Williams Research Corp. The new turbine engine develops 400 hp for use in industrial, military, marine, automotive, oil field, and similar applications. The unit is a free shaft engine that provides high torque characteristics for truck and off-highway vehicle applications and can be converted to a fixed shaft version for alternator drive and other constant speed applications. The unit incorporates a centrifugal compressor, annular combustor, two-stage turbine section, and integral speed reducing gear case.

Westinghouse—A pictorial display of its gas turbine installations as they are applied to natural gas transmission, oil field repressurization, electric power generation, and chemical and petro-chemical services form the exhibit of Westinghouse. Also on display will be an animated gas turbine typical of Westinghouse manufacture along with models of the 12 and 22 mw gas turbine power generating plants. Westinghouse industrial gas turbines range from 4200 to 30,000 hp.

Preliminary Program

Monday, March 6, 1961

9:00 to 11:30 A.M. Session 1

Considerations In The Development Of A Maritime Gas Cooled Reactor Plant by B. T. Resnick, Nuclear Power Engineer, U.S. Maritime Administration, Washington, D.C.

Seapower: Gas Turbines And More Fighting Punch by Rear Admiral R. K. James, Chief, Bureau of Ships, Navy Department, Washington, D.C.

11:30 to 12:30—Cocktail bar open in Exhibit Hall.

12:30 to 2:30—Welcoming Luncheon

Shuttle buses operate all afternoon to outside operational exhibits at the Pentagon.

2:30 to 5:00 P.M. Session 2

The U.S. Army's Gas Turbine Program by Major General G. W. Power, Director of Developments, Office of the Chief of Research and Development, Department of the Army, Washington, D.C.

Air Force Role In Development Of Turbines by Brig. General J. R. Holzapple, Commanding General, Wright-Patterson A. F. B., Development Center, Dayton, Ohio

5:00 to 6:00 P.M.—Cocktail bar open in Exhibit Hall.

8:00 P.M. Session 3

Combustion In Gas Turbines At Light Loads by F. C. Mock, Engineering & Research Advisor, Bendix Products Division, South Bend, Indiana

Use Of Experimental Stage Performance Data To Obtain Optimum Performance Of Multi-Stage Axial Compressors by F. G. Groh, L. E. Brown, Member ASME, Sr. Research Engineer, Curtiss-Wright Corporation, Quehanna, Pa.

Transient Temperatures And Thermal Stress Problems In Small Gas Turbines by R. R. Van Nimwegen, Senior Group Supervisor, AiResearch Mfg. Co., Phoenix, Arizona

Tuesday, March 7, 1961

9:00 to 11:30 A.M. Session 4

A Gas Turbine "Co" Boiler Installation: Economic And Thermodynamic Analysis by C. Bultzo, Sr. Mech. Engineer Humble Oil & Refining Company, Baytown, Texas

The Coal Burning Closed Cycle Gas Turbine by Dr. Curt Keller, Director of R & D, Escher Wyss, Ltd., Zurich, Switzerland

Practical Realizations Of Gas Turbines Combined With Steam And Industrial Heat Cycles by W. Auer, Chief Engr., Brown Boveri & Co., Ltd., Baden, Switzerland

11:30 to 12:30—Cocktail bar open in Exhibit Hall.
Shuttle buses operate all day to outside operational exhibits at the Pentagon.

2:30 to 5:00 P.M. Session 5

Standby Power For Hydro-Quebec Uses Gas Turbine Generators by D. F. Abel, Specialist—Turbine Sales, Canadian General Electric Co., Ltd., Peterborough, Ontario and H. W. Haberl, Asst. Chief Engineer, Quebec Hydro-Electric Commission, Montreal

Gas Turbine Operating Experience At Orlando by C. H. Stanton, General Manager, Orlando Utilities Commission, Orlando, Florida

Application And Operating Experience Of Gas Turbines Used As Hot Air Generators by J. W. Kirkpatrick, Mgr., Turbo Products Eng. Dept., Clark Brothers Co., Olean, N.Y.

5:00 to 6:00 P.M.—Cocktail bar open in Exhibit Hall.

6:00 P.M.—Dinner for those from Overseas sponsored by the General Technical Committee—All welcome.

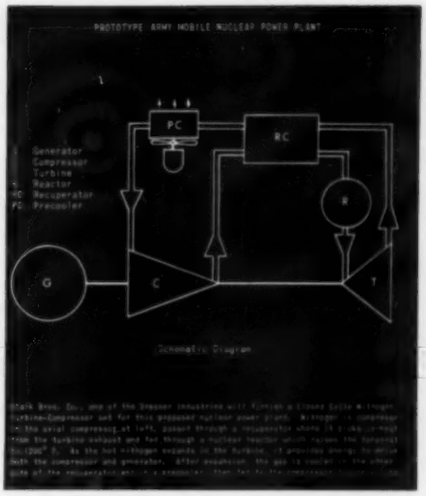
Wednesday, March 8, 1961

9:00 to 11:30 A.M. Session 6

Segregated Structures In Highly Alloyed Ferritic Gas Turbine Wheel Forgings by A. W. Herbenar, Manager and G. B. Heckman, Engineer, General Electric Company, Schenectady, New York

Wheel Spinning by B. O. Buckland, Consulting Engineer, Gas Turbine Department, General Electric Company, Schenectady, N.Y.

Materials Keep Pace With Industrial Gas Turbine Needs by Harry B. Gayley, Gas Turbine Dept., Westinghouse Electric Corporation, Lester, Pa.



11:30 to 12:30—Cocktail bar open in Exhibit Hall.
Shuttle buses operate all day to outside operational exhibits at the Pentagon.

2:30 to 5:00 P.M. Session 7

Shipboard 750 KW Gas Turbine Generator Set by H. P. Karen, Solar Aircraft Company, San Diego, California

A 7,500 SHP Gas Turbine For Naval Boost Propulsion by F. R. Harris, Chief Engineer, Gas Turbine Dept., Turbine Generator Division, Associated Electrical Industries, (Manchester) Ltd., Manchester 17, England

Design And Development Review Of The T-64 Turboprop/Turboshaft Engine by F. F. Ehrich, T-64 Engine Design Engineer, General Electric Co., S.A.E.D., Lynn 3, Mass.

6:30 to 7:30 P.M.—Cocktail party.

7:30 P.M.—Joint Banquet of—
ASME Washington Section
Department of Defense
Gas Turbine Power Division

Thursday, March 9, 1961

9:00 to 11:30 A.M. Session 8

Operation Of 5500 HP Gas Turbines In Locomotive Service by H. Rees, Senior Mechanical Engineer, Union Pacific Railroad Co., Omaha, Nebraska

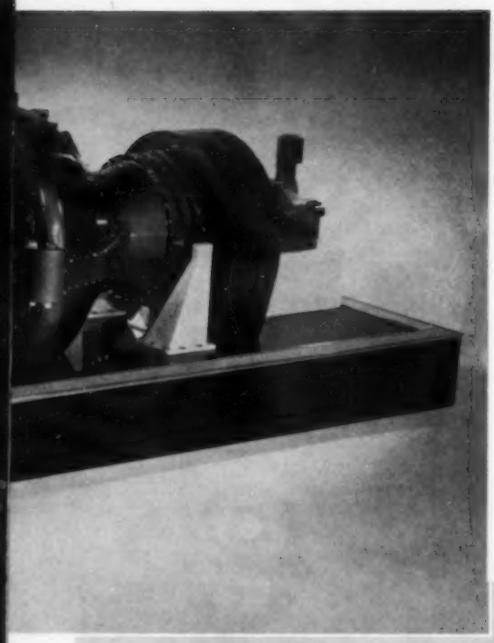
Report On Progress With The Cooper-Bessemer RT-248 Gas Turbine by R. L. Boyer, Vice-President and Director of Engineering, The Cooper-Bessemer Corporation, Mount Vernon, Ohio

Pratt & Whitney Industrial Engineering by W. J. Closs, Manager, Industrial Power Dept., Pratt & Whitney Aircraft, East Hartford 8, Conn.

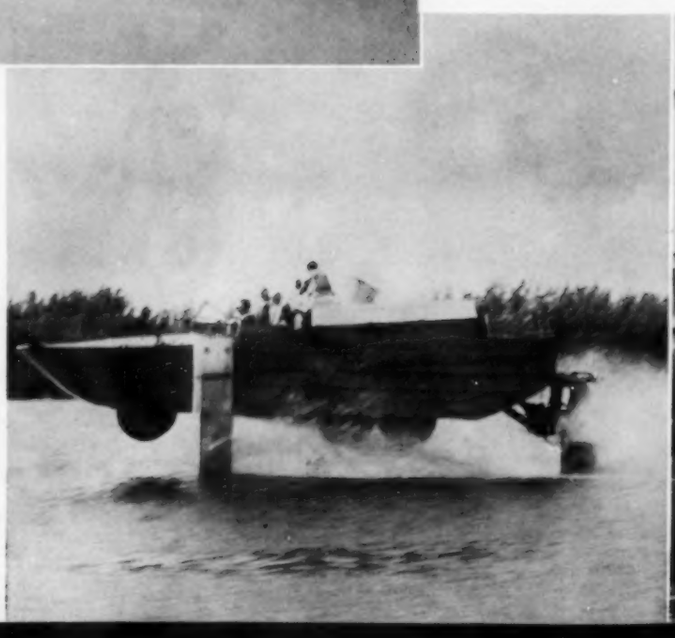
11:30 to 12:30 P.M.—Cocktail bar open in Exhibit Hall.
Shuttle buses operate all morning to outside operational exhibits at the Pentagon.

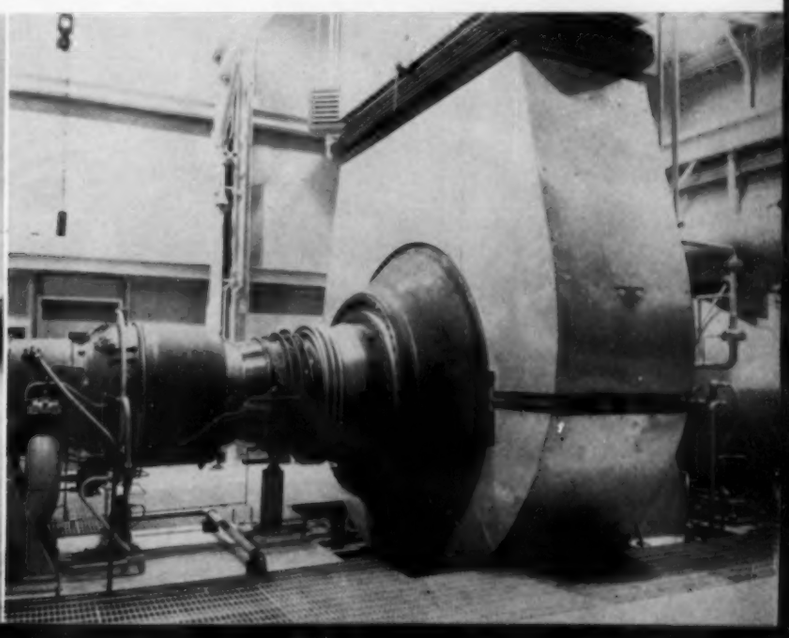
2:30 to 5:00 P.M. Session 9

(Papers for this session have not yet been finalized.)



Powered by a Lycoming T53 turbine engine, the "Flying Duck" flies four feet above the water and is capable of speeds in excess of 40 mph. Hydrofoil was developed for the U. S. Army Ordnance Corps.





10,500 hp Cooper-Bessemer RT-248 gas turbine which drives a centrifugal compressor in the Clementsville, Ky. station of Columbia Gulf Transmission Co. The power turbine is driven by thrust from Pratt & Whitney's modified J-57 jet engine.

555 HP ROTARY SNOW PLOW KEEPS TRAFFIC MOVING

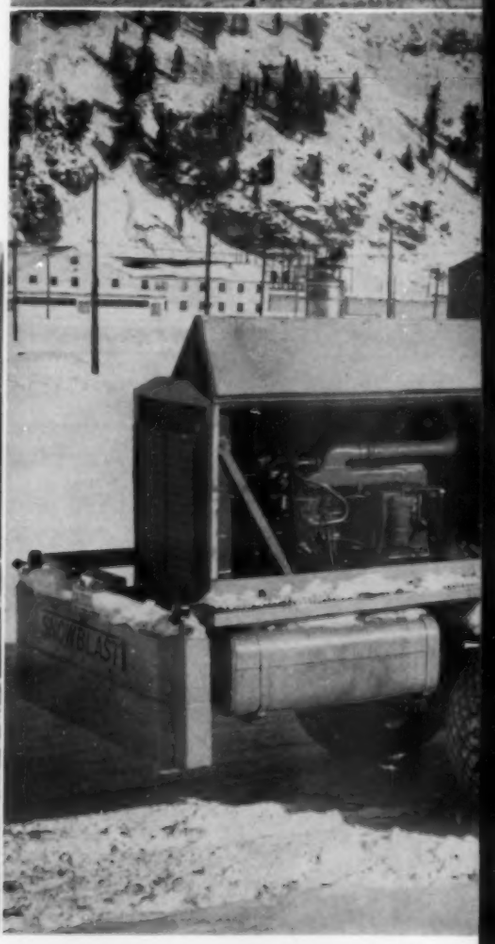
MODERN air and road transportation must be on the go day and night to meet the needs of today's people. For years past, weather has been one of the factors causing delays and expense, with snow accounting for a large part of weather-caused expenses. It might be true that there's little man can do about the weather but modern engineering has been at least able to counter some of weather's effects. One of the units giving a big step forward in opening up snow-clogged roads and runways is the huge Snowblast rotary snow plow manufactured by the American Snowblast Corp. at Denver.

The Snowblast plows models R-2200 H and R-2200 A, have been designed for modern highway and snow removal work under the most rugged conditions. Both of the units are powered with Cummins engines; the carrier or truck is powered with a Cummins model NH-220 and the power train includes an Allison model TC-554 torque converter and TG-602 full power shift, 3 speed transmission. From that point the power train goes through a Coleman transfer case arrangement and locking differential which transmits the power to the drive lines of both axles.

The carrier is a four-wheel drive, four-wheel steer unit and the engine for the carrier is mounted in the rear overhanging the rear wheels to counter-balance the rotary snow plow which is on the front end of the chassis. The hitch for the rotary snow plow is a pivot-type hitch, allowing the use of double acting hydraulic cylinders which provides positive positioning and down pressure, a characteristic not available on other rotary snow plows.

The Snowblast rotary plow system is based on the Swiss Rolba design and operates in two stages: First the snow is separated and gathered by means of rotating cutter blades of special helical design which propel the flow of snow in a direct line toward the impeller housing at accelerated speed, thus preventing turbulence and clogging. Then, the snow is fed through the impeller which operates at approximately twice the speed of the cutters, and accelerated to the velocity necessary for effective casting over distances up to 110 ft. from the chute.

The rotary snow plow power unit is a Cummins NRTO-6-IP turbocharged, 335 hp diesel engine. The power train is through a remotely controlled Wichita pneumatic clutch and a two-speed remotely controlled Western Gear positive lubricated gear box. The drive line goes direct from the bottom of the gear box to the rotary snow plow. The use of the two-speed gear box allows the operator to vary his approach in accordance with the density of the snow. Low gear provides maxi-



Cab of Snowblast plow sits above rotary system which is of the Swiss Rolba design. The snow discharge chute is behind the cab, allows unlimited forward vision for the operator.

mum horsepower for the rotating cutter assembly and somewhat reduced speed and casting range; it is ideal for coping with dense, hardpacked snow. In less difficult snow conditions, the rotary plow is most effective in high gear where it easily attains speeds of up to 30 mph or to have adjustable casting distances such as when used on multi-lane highways or in throwing snow out of deep cuts.

The model R-2200 A is specifically designed for airfield snow removal work, however, it is not limited in this type of operation. The cab for the operator is mounted on top of the rotary snow plow and the discharge chute discharges snow behind the cab, providing unlimited visibility for work around runway lights and other obstacles and in dense highway traffic as found on freeways.

The capacity of the rotary snow plow is 2200 tons an hour with a casting distance of between 85 and 110 ft., depending on the gear ratio selected by the operator. The acceleration of the rotary snow plow engine, the engaging of the pneumatic clutch, and the shifting of the rotary snow plow two-speed gear transmission are all accomplished by one lever to the right of the operator in the cab. This simple control, combined with the lever control of the carrier transmission, makes the operation of Snowblast model R-2200 H or A simple, safe, and requires only one man.

The Port of New York Authority has leased one of American Snowblast's model R-2200 A's for high-speed snow removal at Idlewild International Airport. In tests last winter at Stapleton Airfield in Denver, a model R-2200 A worked behind an echelon of four Caterpillar 12 graders picking up their windrow of heavy, slushy snow and casting it over the lights. The entire snow removal operation on Denver's North-South runway never slowed below 15 mph and in final clean-up around the lights of the last windrow, the visibility and maneuverability of the model R-2200 A allowed 10 to 12 mph operation, in and out of the lights, removing the final bit of snow and the result was that the runway was cleared in one-fourth the time ordinarily taken under similar circumstances.

The R-2200 H has been ordered by the state of Nevada and the state of Colorado. In the case of the state of Colorado, it is their second Snowblast rotary snow plow. The state of Alaska is operating a model R-2200 H powered with two Cummins 265 hp turbocharged engines. The unit keeps the Richardson-highway clear in the area of Valdez, Alaska, and was acquired by the Bureau of Public Roads, who made the purchase before the state of Alaska took the responsibility of clearing their own highways.

Snowblast rotary plow, a model R-2200A with wings, makes a high speed run at 10,000 ft. altitude during a demonstration at Camp Hale, Colo.

View showing engine arrangement for the Snowblast plow. Rear engine, a Cummins model NH-220, drives both axles through Allison torque converter and 3 speed transmission and transfer case to locking differential. Forward engine is a Cummins NRTO-6-IP which drives rotary plow system through a Wichita pneumatic clutch and two speed Western gear box.

Working in Rocky Mountain National Park, rotary plow opens a road covered by six foot drifts at 12,000 ft. level.

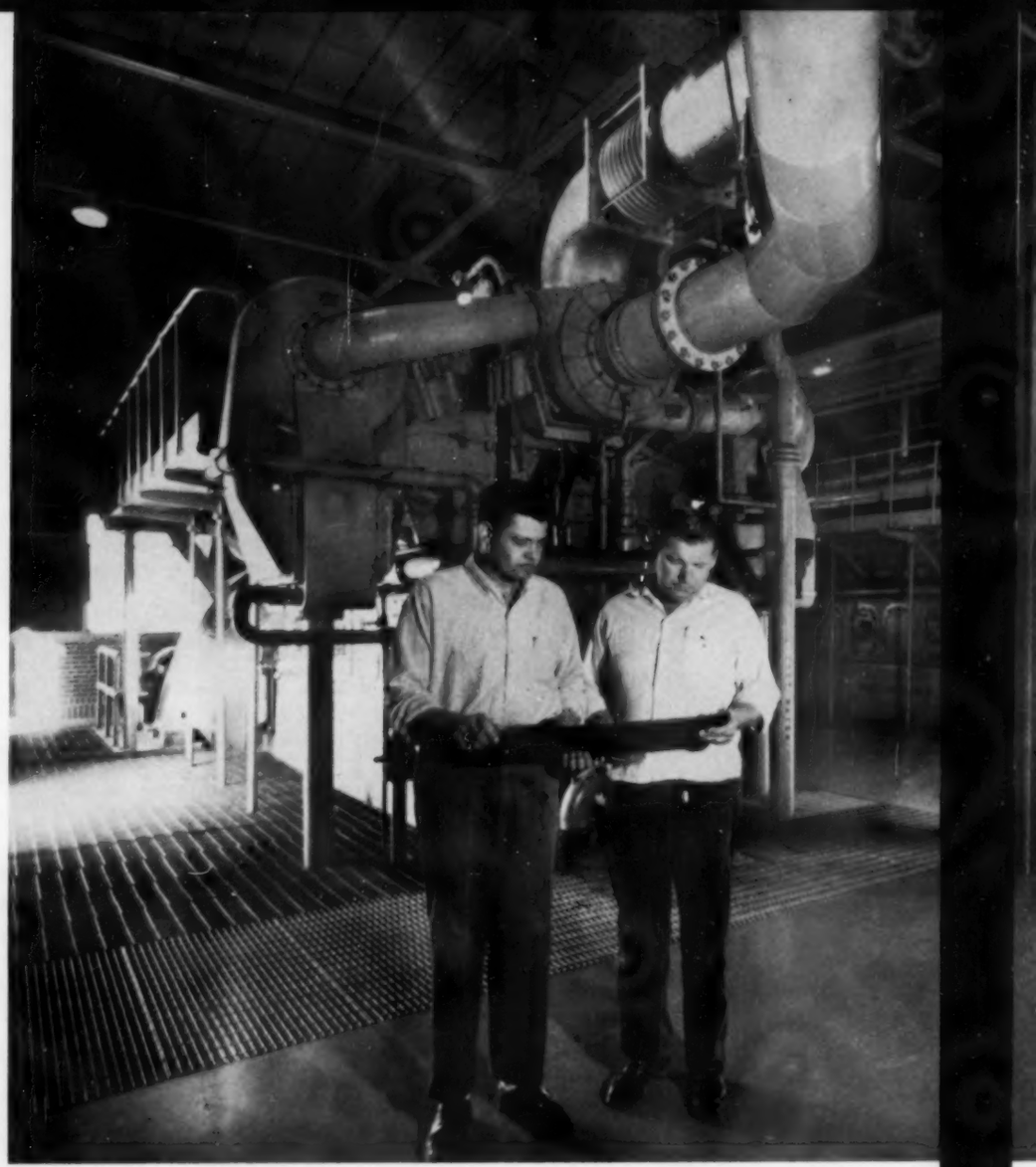
AUGUSTA'S TRI-FUEL LSV-12'S

TWO tri-fuel engines have enabled the Augusta, (Kans.,) municipal electric plant to meet a fast-increasing load demand while keeping costs below all expectations. The turbocharged Cooper-Bessemer LSV-12 units turned in nearly 96 per cent of the plant's total production in 1960 while being officially credited with reducing costs. The tri-fuel feature of the engines combines flexibility of conventional fueling with oil or dual-fuel and also allows easy conversion to spark ignited straight gas operation.

The two engines, installed in 1956, are model LSV-12-GDT-SG units, turbocharged and intercooled 12 cylinder engines. The LSV-12s have a bore of 15½ in. and stroke of 22 in. and are rated 3165 hp at 327 rpm. Each engine is directly connected to an Elliott 2250 kw, 4160 volt generator with Crocker-Wheeler exciter. They joined four engines, totaling 4695 hp, previously installed.

The 1959 figures on just one of the LSV-12s show the economy possibilities of straight gas operation. The engine produced more than 82 per cent of the total Augusta plant output that year at an average fuel cost of just 2.349 mills per kwh although the average load was only 63 per cent. Lube oil consumption was a very impressive 21,790 hp/hrs./gal. Total plant production during 1959 was 13,501,710 kwh and fuel costs were $35,119.95 for an average fuel cost of 2.601 mills/kwh overall.

Supt. Rawlings at No. 5 engine. LSV-12's are turbocharged and intercooled, accounted for 95.7 per cent of total plant output in 1960.



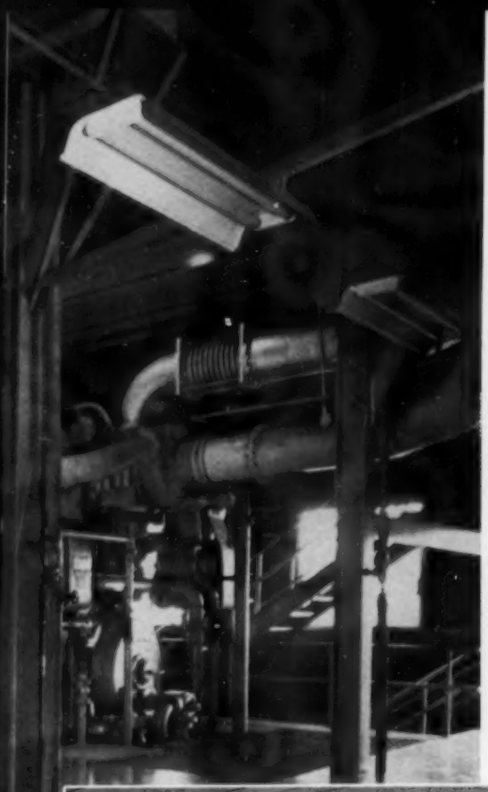
Superintendent James W. Rawlings checks with one of plant operators. In the background are the two Cooper-Bessemer LSV-12-GDT-SG engines, each rated 3165 hp at 327 rpm and each driving Elliott 2250 kw generators.

In spring of 1960 one of the LSV-12 engines was on straight diesel operation for 20 days when gas was not available. The two engines, No. 5 and No. 6, accounted for 95.7 per cent of the plant's total output in 1960 with No. 5 producing 26.7 per cent and No. 6 accounting for 69 per cent of the total. During its 20 days on straight diesel fuel oil operation, No. 5 averaged 14.07 kwh/gal.

Thus of the total plant generation in 1960 of 14,274,997 kwh, the two LSV-12's produced a total of 13,660,347 kwh. No. 6, operating as a straight natural gas engine, was operated a total of 6,655 hrs. and produced 9,849,012 kwh for an average load of 65.4 per cent. Fuel cost per hour of operation on the engine was not available as we wrote this early in 1961 but total plant fuel cost, including operation of all six engines and the 20 day period on straight diesel fuel for No. 5 engine, amounted to $43,049.75 for an average plant fuel cost of 3.015 mills per kwh. Peak load during the year was 4,200 kw, minimum was 675 kw and the average load was 1,479 kw. Fuel oil costs averaged 9.835 cents per gallon; natural gas was 24.39 cents/mcf and the lubricating oil cost was 67¢/gal.

In 1946 the Augusta municipal plant capacity was 1655 kw and numerous minor expansions failed to meet increasing electrical loads. In 1954 a Cooper-Bessemer LS-8-GDT engine rated 1610 hp at 327 rpm and driving an Elliott 1136 kw generator, replaced an obsolete generator set. Although the replaced model was rated only 875 kw, it was possible to fit the 1136 kw unit into the same space, saving appreciably on construction costs. The cooling system at the plant was modified by replacing the old spray pond with a Marley double-flow cooling tower for raw water and installing individual pumps and heat exchangers to replace the common hotwell for engine jacket water. These modifications further increased the Augusta plant's capacity to 3240 kw.

Due to a sudden industrial development and increased use of air conditioning during the hot



The two Cooper-Bessemer LSV-12s were purchased and the units energized just in time to meet a record 3350 kw load—110 kw higher than the previous total plant capacity. The two new engines are housed on the north side of the generating plant in a 50 x 52 ft. addition built flush with the east end of the older structure. The older building houses the four older engines and the main distribution switchboard.

A. C. Kirkwood & Associates of Kansas City, Mo. served as consulting engineers on the 1954 plant expansion, as well as the latest one when the LSV units were installed.

The two new engines are housed on the north side of the generating plant in a 50 x 52 ft. addition built flush with the east end of the older structure. The older building houses the four older engines and the main distribution switchboard. Fuel oil is trucked from the local refinery to two large storage tanks, with total capacity of 40,000 gals., about 75 yards from the plant.

Engines are cooled by individual jacket water systems with shell and tube heat exchangers. Raw water is fed into the two Marley cooling towers through float valves, treated to hold solids in suspension and disposed of through controlled, continuous blowdown. Vertical turbine pumps carry cool water into the plant, through the heat exchangers and back to the top of the tower.

The older portion of the Augusta plant is operated at 2400 volts and the LSV-12s at 4160 volts through an outdoor type switchgear. A tie circuit with a 1500 kva auto-transformer is run from the outdoor gear to the indoor switchgear in the older part of the plant, thus, in effect, the two separate plants are paralleled together.

Engine crankcases are filled with Mobil DTE oils. Fuel oil used is Mobilfuel diesel medium and the Cities Service Gas Co., supplies the natural gas. Preventative maintenance procedures are followed with routine checks made of crankshaft alignment, bearing clearances, test stand checks of nozzles, and filter replacements. In the case of the spark ignited engines, spark plugs are changed, ignition points set or replaced, timing set every 3000 hours.

The Augusta municipal plant provides service for a total of 2584 accounts through 29 miles of distribution lines. James (Jim) Rawlings is superintendent of generation for the city-owned plant; his assistant is Dean Burden, and Frank Douthitt is superintendent of distribution. Mayor R. A. Blowey, the city council and City Manager G. J. Boyd oversee municipal policies.

Principal Equipment Serving Cooper-Bessemer LSV-12-GDT-SG Engines

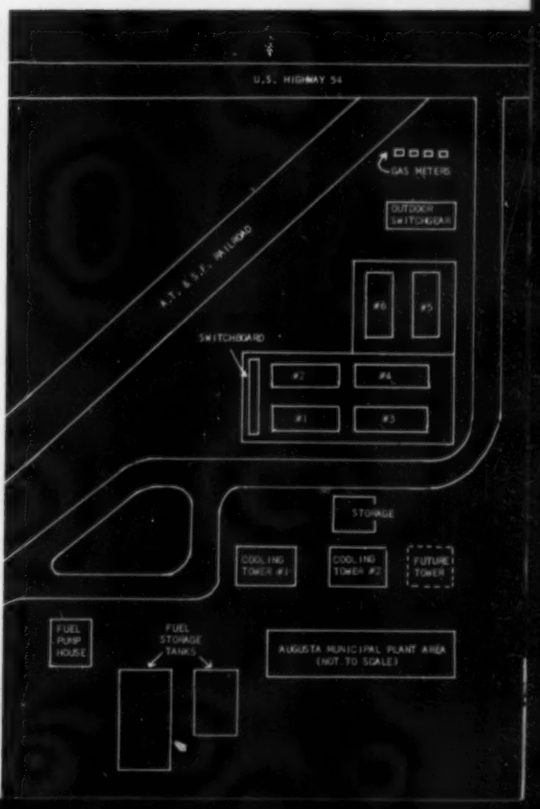
Generators	Elliott
Exciters	Crocker-Wheeler
Governors	Woodward
Starting air compressors	Quincy
Gas meters	Roots-Connersville
Lube oil strainers	Elliott
Lube oil coolers	Ross
Raw water pumps	Worthington
Heat exchangers	Ross
Thermostatic controls	Fulton-Sylphon
Before-and-after lube pump	DeLaval Imo
Air intake filters	American
Exhaust Mufflers	Maxim
Exhaust pyrometer	Alnor
Jacket water pump	Allis-Chalmers

Exterior of the Augusta electric plant. Portion of plant to left houses the LSV-12 engines. Visible on roof are the American Cycoil air filters, Maxim exhaust silencers.

summer months, peak load reached 2800 kw only a few months after this improvement—coming about 450 kw shy of the total nameplate rating. Major expansion seemed the most economical answer in view of the growth in peak load through the years:

Year	KW Produced	Peak Load	Peak Load Increase %
1952	5,624,530	1520	
1953	6,654,050	1750	13
1954	8,796,970	2030	14
1955	10,557,590	2800	27.5
1956	12,307,570	3500	20
1957	12,248,350	3600	3
1958	12,149,990	3600	—
1959	13,501,710	4100	14
1960	14,274,997	4200	3

Sketch of Augusta plant layout. (Not to scale.)



GAS TURBINE POWERS NEW FIRE TRUCKS

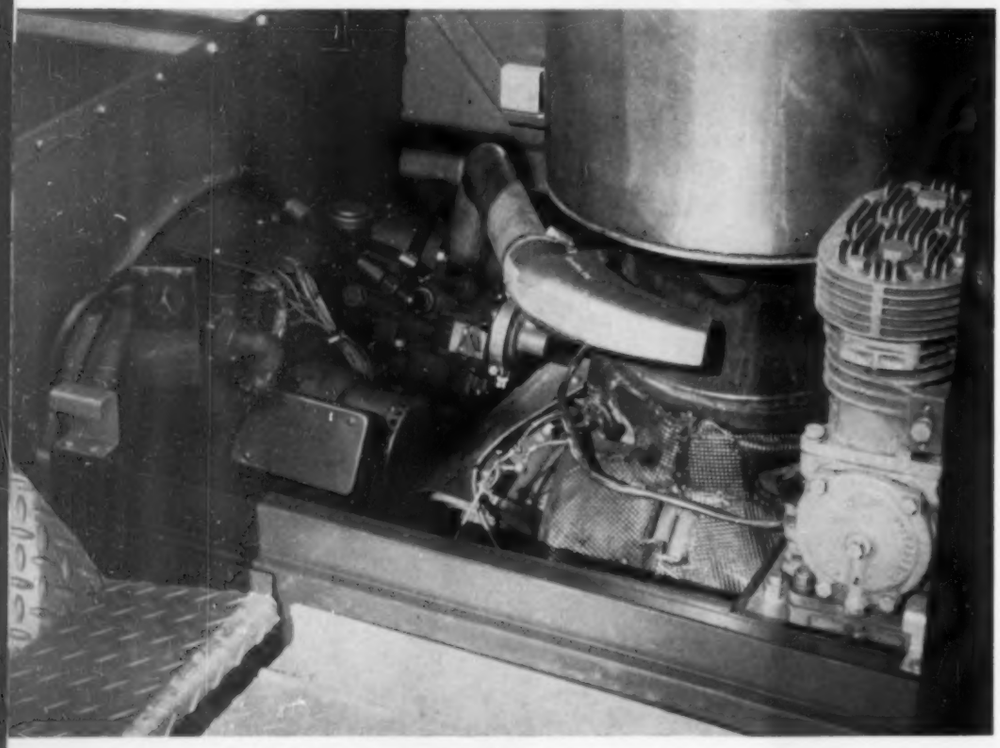
A NEW fire truck that joined the ranks of the San Francisco Fire Department recently sports a stainless steel stack that indicates a unique installation "underhood." The sparkling exhaust stack is the only outward sign that at the other end is a gas turbine that drives this unique piece of fire apparatus, the first so powered.

The new truck, a 1000 gallon per minute pumper, was delivered recently to the San Francisco department by American LaFrance Corp., Elmira, N.Y. The gas turbine installed in the pumper is a Boeing model 502-10MA. A similar turbine has been installed in a 100 ft. aerial ladder truck built by American La France for the Seattle (Wash.) Fire Department.

When the San Francisco and Seattle departments decided to specify turbine power in these new trucks they were looking for solutions to two problems: ability to climb the steep hills, which comprise large areas of the two cities, with minimum gear shifting and sustained speeds, and ability to get started on a fire call without waiting for normal gasoline engine warmup. The Boeing turbine, with high torque performance at low speeds, passed the hill test. And, since the turbine requires no warmup, the truck can get moving quickly when the alarm rings.

The Boeing 502-10MA turbine installed in the San Francisco truck is rated 330 shp at maximum gas producer speed of 38,500 rpm and optimum governed output shaft rpm of 3400 rpm. Normal continuous rating is 300 hp at 38,000 gas producer rpm and 3300 output shaft rpm. The turbine unit weighs 325 lbs., slightly more than one per cent of the total truck weight of 31,500 lbs.

The model 502-10MA gas turbine is a further development of the model 502-10C, retaining the basic mechanical configuration of the latter. Primary changes to achieve increased power and reduced fuel consumption are a new compressor design and improved materials in engine hot components. The engine consists of two major sections: a gas-producer and a power-output section. The gas producer contains a single-entry centrifugal compressor coupled to a single-stage axial-flow turbine, two cross-sectioned combustion chambers of the through-flow type, and an accessory drive section. The power output section incorporates a second axial flow turbine, reduction gearing, and a flanged output shaft. The reduction gear housing is also flanged to allow direct attachment to a stationary transmission housing. There is no mechanical coupling between the turbine rotors of the gas producer and the power-output section. This arrangement permits the gas pro-



Gas turbine installation on the San Francisco pumper. Front of vehicle is to the left. Turbine did not require any changes in driveline components which are the same as those installed in conventional engine setup.

Thus installation of the gas turbine did not require any changes in the standard drive line set-up back of the flywheel. In fact, except for replacing the regular engine with the gas turbine, the drive line arrangement is the same. Of course, radiator and cooling system are eliminated.

The water pump on the San Francisco truck is American LaFrance's regular Twinflow 1000 gpm unit and again, there were no changes in the driving mechanism to adapt it to the turbine prime mover. The Twinflow pump is of the parallel-series centrifugal 2-stage type with 10¾ in. bronze impellers and hardened stainless steel shaft. The pump transmission gears are forged steel heat treated with the gear teeth having a ground and lapped finish for accuracy and quietness. The pump is designed to accommodate front, rear and side suctions for hard suction hose, or soft suction hose pre-connected or squirrel type in a variety of sizes. The pump is driven in direct or fifth gear of the main transmission through a takeoff to give a 1:1.312 ratio.

Turbine-powered fire pumper delivered recently to the San Francisco Fire Department. Gas turbine is installed behind driver's compartment below stainless steel exhaust stack. Turbine drives through five speed Spicer transmission.

Artist's drawing of Seattle 100 ft. aerial ladder truck which will also have Boeing 502-10MA gas turbine, showing installation.

In acceleration tests, the 31,500 lb. pumper has turned in a zero to 50 mph performance in 45 seconds from a "cold and 'dead' " engine starting. From a standing idle the truck has accelerated from zero to 45 mph in 26 seconds.

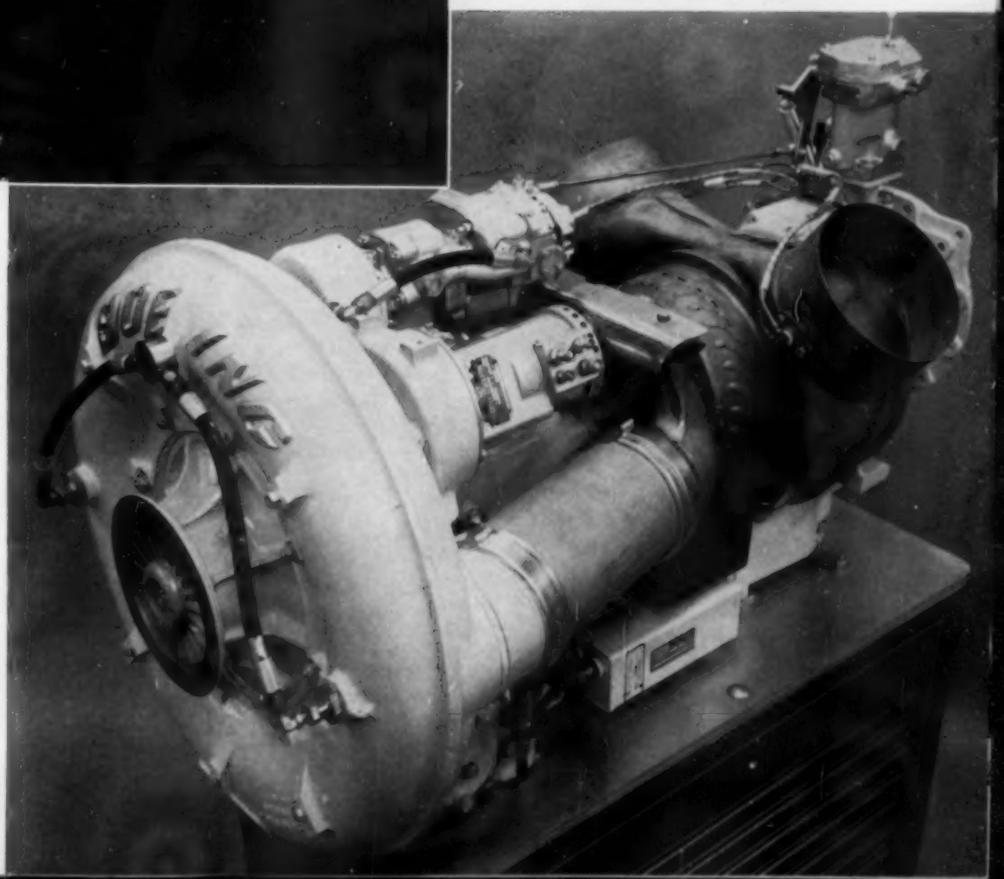
Prior to delivery the pumper was put through the standard National Board of Fire Underwriters tests at LaFrance's Elmira plant. Here are figures from the various tests:

Test Duration	Output Shaft RPM	Pump RPM	Ave. GPM Discharge	Pressure Per Sq. In.	Pump Stage
6 Hrs.	2255	2961	1013	152	Par
3 Hrs.	2760	3621	706	200	Par
3 Hrs.	2030	2649	501	258	Series

In the first two tests water was pumped through two 50 ft. lines of 2½ in. dia. CRL hose, each with 1½ in. tip. The third test was through one 50 ft. line of CRL, 2½ in. hose with a 1¼ in. tip. All tests were run with a suction head of 10 ft. Tests were also conducted on a 1250 gpm and a 1500 gpm Class A Underwriter's test so the turbine engine can be provided in three different Class A capacity ratings.

On the Seattle fire truck the turbine installation is the same as on the San Francisco unit. But since there is no pump on the Seattle apparatus, the drive is direct from transmission to rear axle.

View of Boeing 502-10MA gas turbine. Unit is rated 330 shp at maximum gas producer speed of 38,500 rpm and output shaft speed of 3400 rpm. Note Woodward governor.



ducer speed and engine power to be controlled independently of the output shaft speed resulting in an engine with output speed variable from 0 to 110 per cent of rated rpm for either full or part-throttle operation.

The engine drives the transmission through a Spicer 14 in. dia. two plate dry disc type clutch. The transmission is a Spicer 6852F synchromesh five speed unit with 3.60:1 ratio in first and 1:1 in fifth. Reverse gear is of 3.6:1 ratio.

Installation was with the center of the turbine engine along the centerline of the crankshaft of the conventional six cylinder gasoline engine which normally powers American LaFrance apparatus of this rating. The support brackets for installation of the turbine are similar to those used for conventional installations and the clutch and transmission are mounted directly on a housing at the rear, the same as normal installation.

CHARLESTON PILOT II

THE Charleston (S.C.) Pilots Association recently took delivery on a new pilotboat specially equipped with a "jogging" engine to help the boat keep on station without need to run the main engine on idle for extended periods of time. The new boat is 60 ft. long, has a beam of 17 ft. and depth of 9 ft. and draws 6 ft. 9 in. The boat was developed from smaller pilot boats previously built by Gladding-Hearn Shipbuilding Corp., Somerset, Mass., builders of the newest vessel.

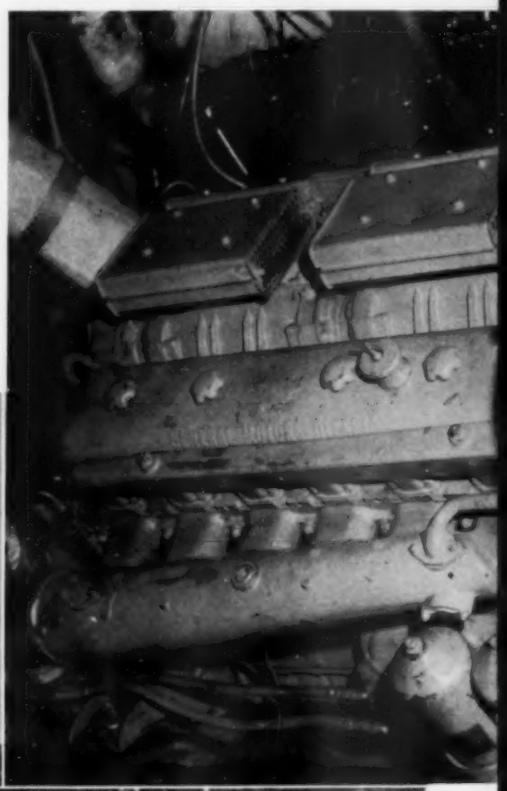
The exposed position of the Charleston station, some six miles offshore, combined with relatively shallow water makes extremely rough seas . . . and sea keeping ability was considered more important than speed in design considerations. It was desired though to make the 13 mi. run to and from the pier in minimum time. At the builder's trials the *Charleston Pilot II* reached a speed of 11 knots at rated engine output.

Main propulsion power is furnished by a General Motors 12V-71 engine rated 335 hp at 1800 rpm. This engine turns a 44 in. x 34 in. three-bladed propeller through a 3 in. Monel shaft and Twin Disc 3:1 hydraulic reverse-reduction gears.

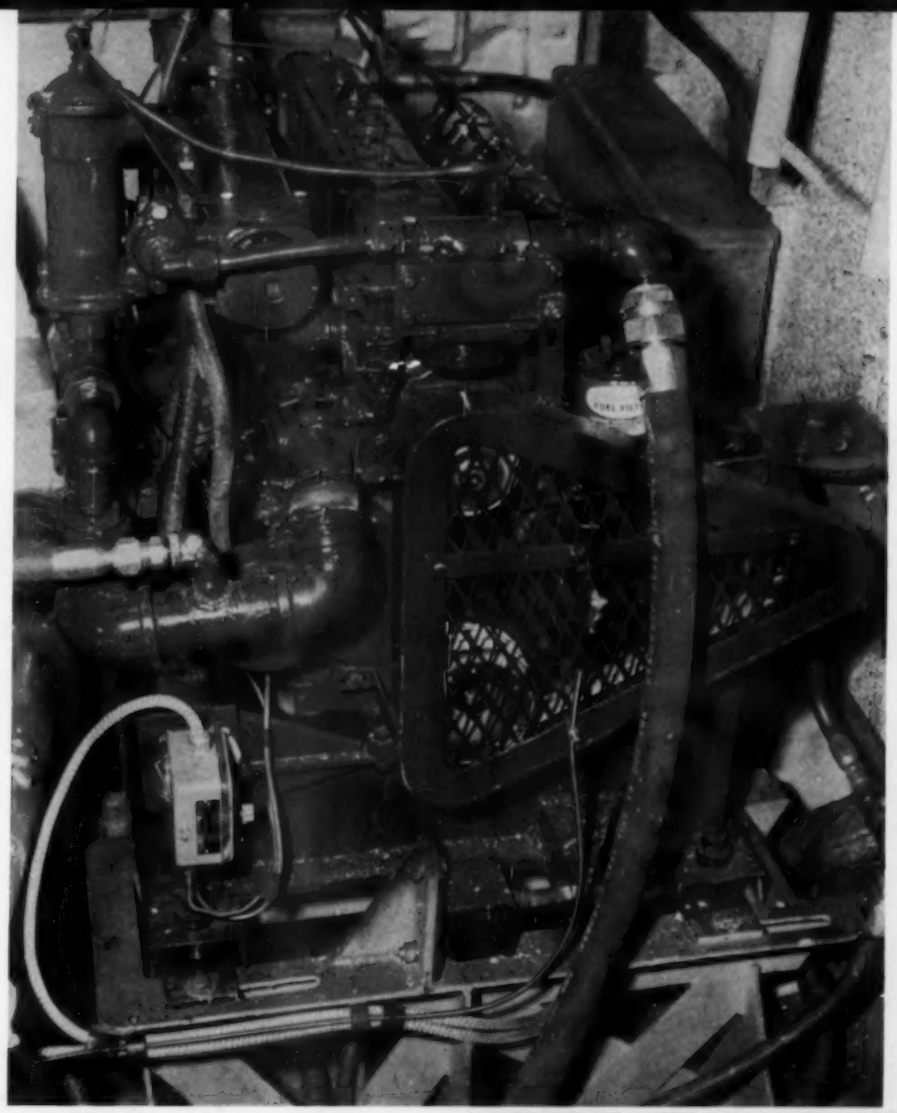
A unique feature is the installation of a small "jogging" engine alongside the main engine driving the main shaft through V-belts to provide the necessary steerageway and control while maintaining station. A Waukesha model 197DLCM marine diesel engine fitted with a 1.5:1 Capitol reverse reduction gear was used for this purpose. Ten Dodge "Dyna V" belts effect an additional 3.15:1 reduction and drive the main shaft. At a speed of 1200 rpm, (corresponding to 40 hp) the Waukesha auxiliary engine pushes the boat at 5.6 knots. This auxiliary arrangement eliminates the need for running the main engine at idle speed for extended periods and provides the added safety and convenience of being able to perform pilot service or return the vessel to port in the event major service is required on the main engine.

Battery failure had been a problem with the Charleston pilots in previous boats and their specifications called for the elimination of all batteries. This was accomplished by using an American Bosch Hydrotor starting system whereby main, auxiliary and generator diesel engines are started by hydraulic motors turned at 2000 psi from a reservoir of hydraulic fluid compressed by an electric motor-driven pump (or hand pump in emergencies) against nitrogen contained in two high-pressure cylinders.

Effective suppressing of engine noise transmission to the steel hull was accomplished by mounting all engines on rubber mounts and using a flexible coupling on the main shaft. All piping to the machinery was by Aeroquip flexible hose, which was also used extensively for bilge, hydraulic, fuel and cooling systems. Engines are skin cooled through channels welded externally on the hull.



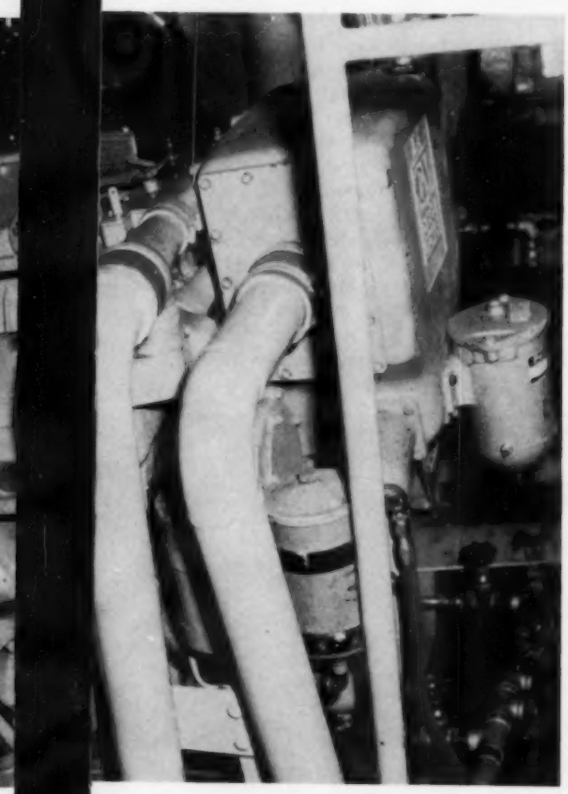
Charleston Pilot II **during her trial runs. New vessel is 60 ft., long, was built by Gladding-Hearn at Somerset, Mass. Four diesel engines supply propulsion, "jogging" and electric power aboard the trim craft.**



Waukesha model 197DLCM diesel engine provides "jogging" power to main shaft to allow Charleston pilotboat to maintain station offshore without running the main engine at idle for extended period. This engine can propel boat at about 5½ knots at 1200 rpm speed driving 1.5:1 Capitol marine gear and V-belts affecting an additional 3.15:1 reduction. Note Roosa Master fuel filter, Aeroquip hoses.

Electrical power is 110v ac throughout and is generated by two model 10ROT27 10 kw Kohler electric plants driven by 4 cylinder Waukesha model 180DLC diesel engines. It is intended to alternate the sets each day so that a preventative maintenance program may be maintained, in addition to providing the necessary stand-by power. Distribution from either generator or shore is via a 20-circuit switchboard and distribution panel.

Hand steering is employed through a positive me-



chanical system by roller chains, sprockets, and shafting to a 20:1 speed reducer in the lazarette which is connected to the rudder stock by double roller chain. This arrangement is virtually self-locking and eliminates back-torque to the wheel from the large rudder when backing down to clear a ship and provides a high degree of power and reliability. The hull is constructed of ¼ in. plate on transverse frames spaced every 18 in. Rubber fendering replaces conventional split pipe guards and/or old tires.

Navigation aids include a Raytheon model 1500 radar for picking up incoming ships, a 6 in. spherical compass, automatic fog horn actuator, depth sounder, radio telephone with remote control in pilot house and VHF mobile radio unit.

Main propulsion power on the pilotboat comes from this GM model 12V-71 diesel engine rated 335 hp at 1800 rpm. Engine drives through Twin Disc 3:1 hydraulic reverse-reduction gear. Note Perry water filter.

One of two diesel-generator sets aboard the *Charleston Pilot II*. Kohler 10 kw generator is driven by Waukesha 4 cylinder model 180DLC diesel engine. These engines, as well as main and "jogger" engines, have American Bosch Hydrotor starters.

Principal Equipment

Main engine	GM Detroit
Auxiliary engine	Waukesha
Generator sets	Kohler
Flexible hose	Aeroquip
Hydraulic starters	American Bosch
Marine gear	Twin Disc
Propeller	Federal

CLEARING MINUTE MAID'S NEW GROVE

By ED DENNIS

SWAMP lands are yielding to men and machines as the Minute Maid Corp. develops the world's largest Valencia orange grove west of Fort Pierce, Fla. The whole Florida citrus industry is interested in the outcome of Minute Maid's new undertaking. And without high production dieselized earth moving equipment the 6800 acre project would be almost impossible, said Cecil Wrenn, superintendent of construction and machinery for the new Minute Maid grove.

Company officials predict the new grove, when fully developed, will produce about 1,800,000 boxes of oranges each season. Grove owners, in the interior, of the citrus belt, questioned the economics of planting on low ground. But strangely enough, the cost of putting this land into shape for planting should run about $250 per acre, which is no more than it would be for preparing and equipping a conventional grove in the interior. Conversely two of the biggest advantages of low grove land are less susceptibility to frosts and a higher "pounds solid" yield per box of oranges.

The basic problem is drainage and the pumping of vast amounts of water. Minute Maid Corp. will solve the pumping problem with nine pumping stations containing 12 Couch 36 in. 20,000 gpm turbine water pumps, each powered by a model D318 Caterpillar diesel engine. These six cylinder naturally aspirated Cats have a bore and stroke of 4½x5½ in. and develop 137 hp at 2000 rpm. The units now in operation consume seven gallons of fuel oil per hour during pumping operations. The pumps can remove, under flood conditions, two inches of rainfall every 24 hrs.

A one square mile reservoir area will provide storage of approximately ten acre-inches of water for irrigation purposes. Some of the pumping units can be reversed by siphoning action to supply water when irrigation is necessary.

This land, being in the St. John's Marsh area, was practically all under water at the start of the project. Construction plans called for the ditch and dike method as it is faster and cheaper than regular landfill with long dirt hauls. The entire 6872 acres will be enclosed in a "Florida type Great Wall" dike about 18 mi. long and having a base width of 40 ft., top width of 10 ft. and a height of about eight ft. The enclosed area will contain, in addition to the peripheral dike, 25 mi. of lateral canals, 23 mi. of sub-lateral canals and 350 mi. of grove ditches. More than four million cu. yds. of material will be moved in the process of digging ditches and building dikes.

The heart of this intricate system will be the dry beds nearly 135 ft. wide on which the orange trees will be planted. To do this vast job about a $500,000 worth of new dieselized equipment, including draglines, dozers, graders and portable electric plants, were brought into this swampland. The construction cost of the entire project from the raw land to a diked, ditched, bedded and water controlled grove is estimated at slightly less than $1.5 million exclusive of land and tree costs. Total cost of land, trees preparation and growing the trees to a five year old stage is estimated at approximately $5 million.

In the basic excavation two model 38 B Bucyrus-Erie draglines with 80 ft. booms and 1¼ yd. buckets were used in forming the perimeter dike. Powered by 225 hp, model D342 Caterpillar diesel engines driving through Twin Disc clutches, these draglines have been moving approximately 2000 yds. of material in a ten hour day.

Before the water is drained from each new section a couple of GM dieselized (4-71) Link-Belt Speeder 98's are brought into action to dig the lateral ditches every half mile. Final phase of the draining project takes place when the model 68 Link-Belt (GM 3-71) draglines with ¾ yd. buckets open the six ft. wide grove ditches to connect to the lateral canals.

The clearing and grubbing, which varies from

One of the two #38 B Bucyrus-Erie 1½ yd. draglines at work on the peripheral or main dike. Unit is powered by a model D342 Caterpillar diesel through a Twin Disc clutch.

A Caterpillar powered pumping unit before the shed is built around it. Model D318 Caterpillar diesel is rated 137 hp at 2000 rpm, drives a Couch 36 in. dia., 8 ft. head, 20,000 gpm, 420 rpm pump via V belts.

A model 995 Oliver Lugmatic tractor powered by a General Motors 3-71 diesel and Allison torque converter is used to pull a Be-Ge Rotohaul scraper.

part of the Central & Southern Florida Flood Control Project.

The company is also utilizing three D7 Caterpillar dozers, one molel 12 Caterpillar grader and one Austin-Western grader with a 3-71 GM diesel and Allison torque converter plus five boats and two swamp buggies.

Up at the work shed and office, the firm has two temporary light plants. One is a 25 kva 120 volt 208 amp 1200 rpm Westinghouse generator powered by a GM 4-71 diesel and the other an 18 kva General Electric generator set powered by a 4 cylinder International Harvester diesel engine.

As most of the machinery is only a year or so old, major mechanical breakdowns have been nil. The company operates a field oil and grease truck. Mechanics grease and change oil and filters every 75 hrs. on the draglines and other machinery. On the Cat pumping units lubricating oil and filters are changed every 120 hrs. Air filters, fuel oil strainers and any minor engine machinery adjustments needed at this time is taken care of too.

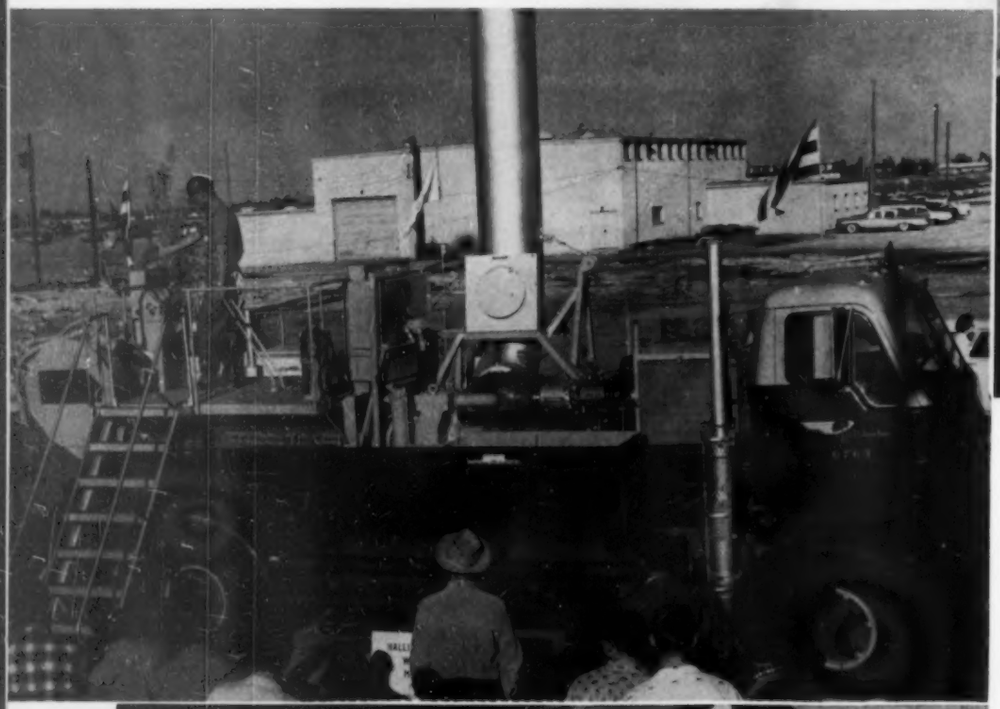
swamp grass to trees on the hammocks, is done by three D7 Caterpillar dozers. The same equipment along with a model 12 Caterpillar and an Austin-Western grader levels off the material piled up by the draglines. An Oliver Lugmatic model 995 GM dieselized tractor hauling a Be-Ge-Rotohaul scraper is used along with the motor graders to finish the job of grading and crowning the grove sections between the ditches. The Caterpillar powered pumping units will pump the water over the main 18 mi. dike and into the main drainage canal which surrounds the new grove. The water then flows to the ocean through canals that are

After draining, clearing and planting. The first 80 acres of trial section of the grove. Also shown is a section of the 350 mi. of grove ditches.

Minute Maid will construct a large and complete maintenance shop to care for approximately 72 pieces of equipment necessary to maintain the grove. The grove is named in honor of Holman R. Cloud, the man who pioneered Minute Maid's acquisition of grove property. Plans were recently announced by the company for the conversion of a six sq. mi. tract near Indiantown, into another huge citrus grove on the order of the Cloud grove. Minute Maid now owns or operates nearly 30,000 acres of citrus land in Florida. The 1958-59 citrus crop in Florida had a value of $292 million and growers expect '60-61 to top this, perhaps hitting the $300 million mark.

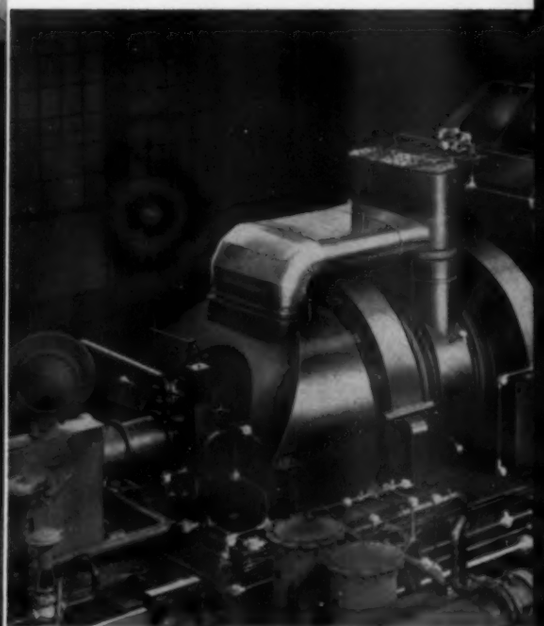
GAS TURBINES IN ACTION

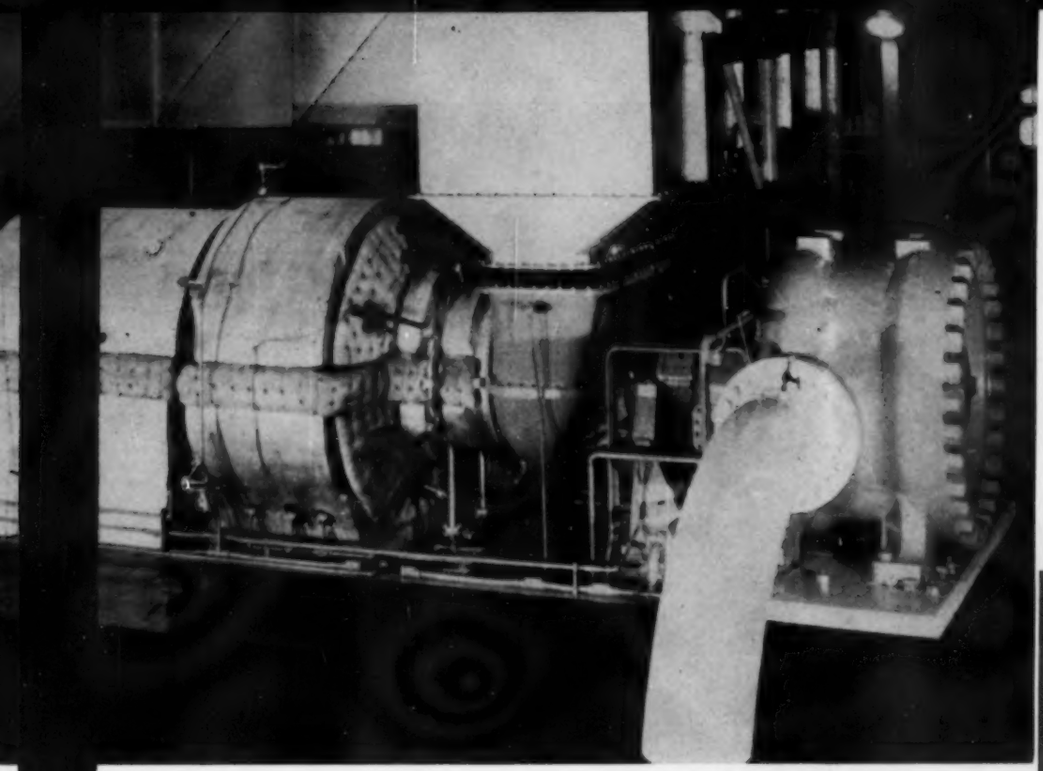
Here is a Pictorial Report of Some of The Latest Gas Turbine Developments and Applications



Mobile oil well fracturing unit owned by Halliburton Oil Well Cementing Co. is powered by a 900 hp General Electric model 720 gas turbine engine. During a 22½ minute test conducted by Halliburton the turbine, driving a standard HT-400 pump, pumped 18,000 gals. of water and 20,000 lbs. of sand into the hole. Maximum injection pressure was reported at 1750 lbs. and maximum injection rate at 27½ bbls./minute.

AiResearch GTCP gas turbine compressor and power unit is shown servicing a TWA Boeing 707 commercial airliner. Unit is similar to panel truck mounted units and provides compressed air for starter, and electric power. Single power, either air or shaft, may be extracted or power is furnished in combined ratings to 55 shaft hp and 188 lbs./min. airflow.



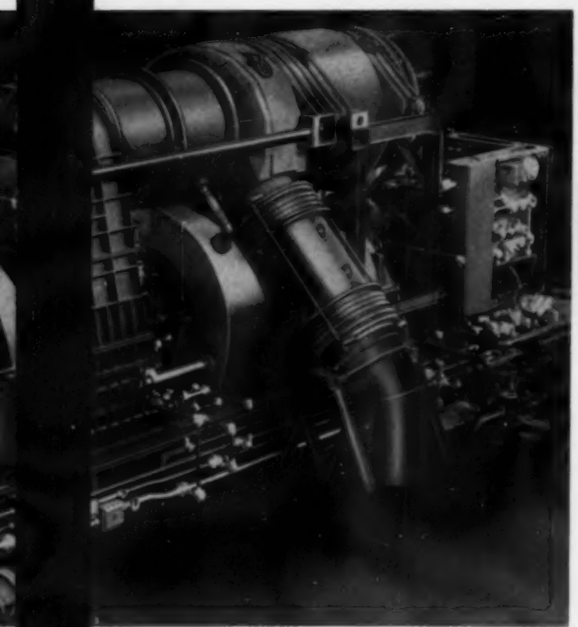


Here is one of Westinghouse Electric's latest gas turbine installations. Shown is a 7500 hp unit of the regenerative cycle, single shaft type driving a centrifugal type compressor for gas pipeline transmission. This Westinghouse turbine is installed by one of the major transmission companies in a mainline Tennessee station.

A gas turbine powered tractor, one of the first applications of turbine power on earth moving and construction equipment, is currently undergoing tests at the U. S. Army Engineer Research and Development Laboratories in Ft. Belvoir, Va. The tractor is a Caterpillar model DW-15 powered by a GMT-305 Allison gas turbine. The tractor is a standard rubber tire model but modified by Allison to accommodate its turbine engine. This turbine weighs approx. 600 lbs. It has a normal rating of 225 hp, but is rated at 206 hp in this particular application.

This oil well fracturing rig owned and operated by The Western Co. of Fort Worth, Tex. is currently in operation in the Texas oilfields. Powered by a Solar Saturn T-1000 gas turbine engine driving a new design Western Co. lightweight pump, the weight of a truck and fracturing unit is approx. 23,000 lbs. The 1100 hp Saturn and Western pump will deliver 1000 hydraulic horsepower per unit.

One of the Clark Bros. model 305 regenerative cycle, two-shaft gas turbines rated 8370 hp each which will drive Clark 30x30 in. single stage centrifugal pipeline compressors to pump approx. 700 million cu. ft. of gas/day through one of world's longest gas pipelines. Clark is delivering three of these turbine-compressor sets to Trans-Canada Pipe Lines Ltd. to power three new stations in its expansion program to deliver gas to the U. S.

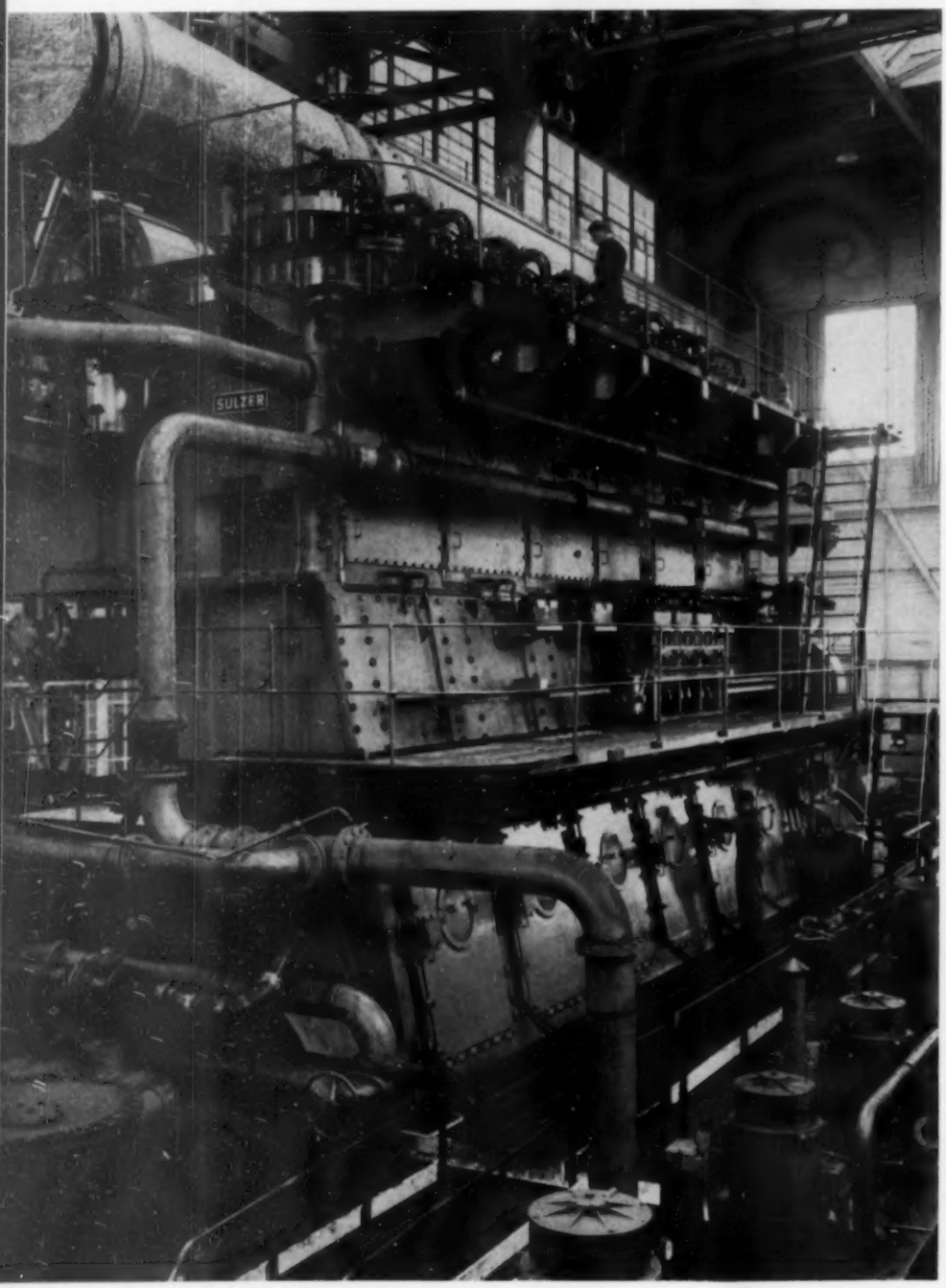


Shown cutting the waters of Seattle's Lake Washington is a 26 ft. stock express cruiser powered by a 260 shp Boeing marine gas turbine engine weighing 625 lbs. This is one of the most recent Boeing marine turbine installations and is being used in tests of various marine systems and instrumentation. Top speed of the boat is 33 mph.

SULZER EXTENDS RANGE TO 24,000 HP

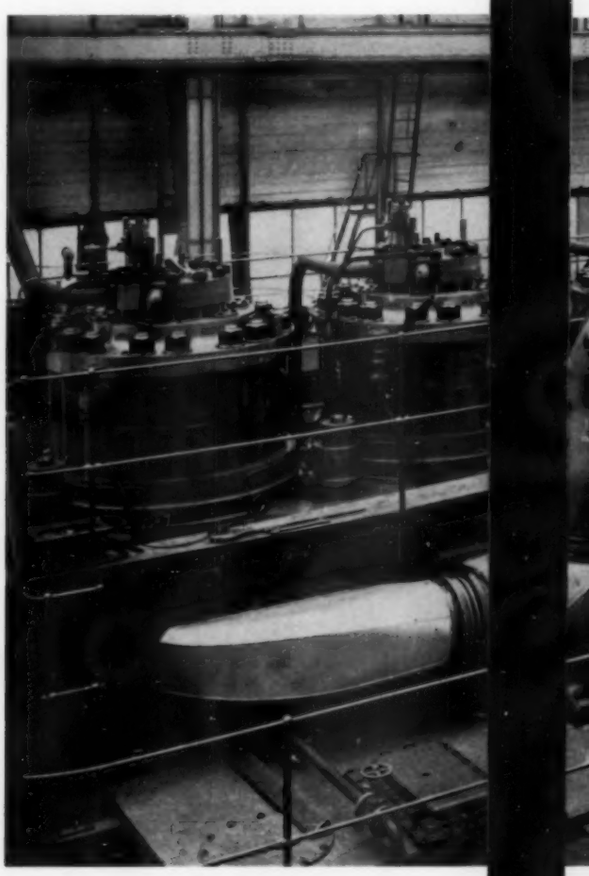
SULZER Brothers Ltd. have extended the power range of their turbocharged two-cycle marine diesel engines of the RD type in both lower and higher ratings. The new line of RD engines was introduced late last year in a demonstration at the firm's Winterthur, Switzerland works to about 600 engineers and trade representatives. The engines, comprising the RD models 56, 68, 76 and 90 cover the range from 3,750 up to 24,000 bhp (metric). The lowest output of 3,750 bhp is developed in the 5RD56, a five cylinder unit with bore of 560 mm (22.04 in.) and stroke of 1000 mm (39.37 in.). Its rating per cylinder is 750 bhp (metric) at 170 rpm. The highest output is attained by the new 12RD90, a high-duty engine with 12 cylinders in line, a bore of 900 mm (35.43 in.), a stroke of 1550 mm (61.02 in.) and output of 2000 bhp (metric) per cylinder at 119 rpm.

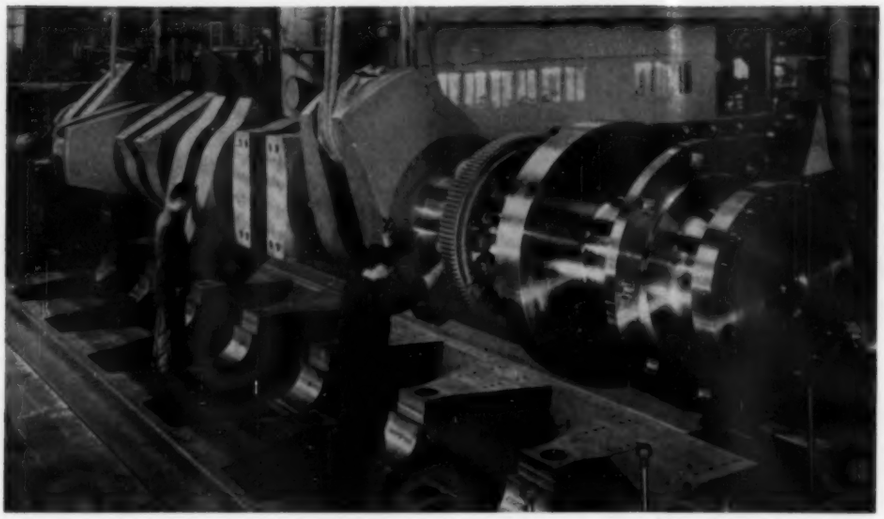
All of these units are single acting, reversible, turbocharged, two cycle engines of crosshead construction, intended primarily for single screw vessels and for direct coupling to the propeller. The trend in shipbuilding toward increased deadweight capacity and higher speeds for cargo vessels and tankers calls for raising engine outputs and this has been one of the main preoccupations at Winterhur in the last few years. The rating of 2000 bhp per cylinder for the RD90, corresponding to a mean effective pressure of 7.65 kg/cm² (108.8 psi), can be substantially increased, say Sulzer engineers, by suitable adaptation of turbochargers and fuel injection equipment, as the engine itself is capable of higher outputs. Mean effective pressures of 10 kg/cm² and more are quite within



Fuel pump side of new 6RD90 marine diesel engine, which is equipped with two turbochargers and has a nominal rating of 12,000 hp at 119 rpm.

The two Sulzer exhaust-gas driven turbochargers of type RT67 are connected through separate filters to the lubricating circuit of the 6RD90 two-cycle engine.





Crankshaft of Sulzer 6RD90 diesel engine. The shaft with its six cranks weighs 71 tons; journal diameter is 625 mm, or just over two ft.

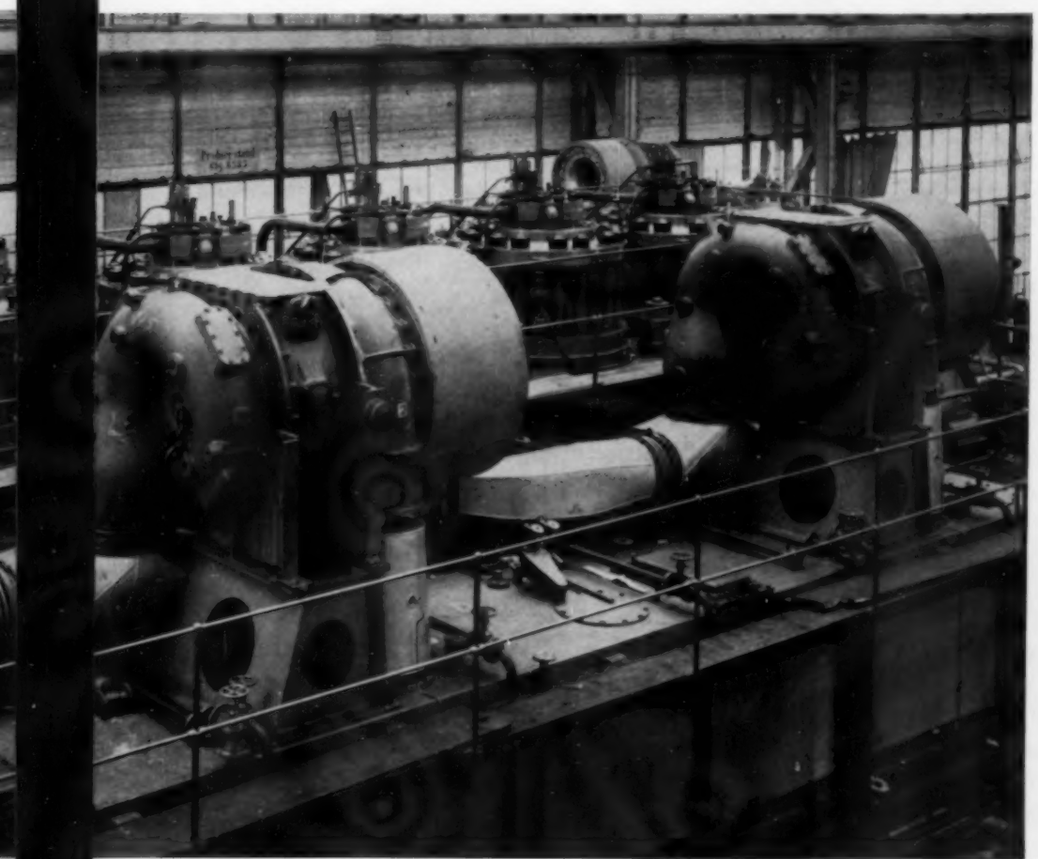
the limits of feasibility, they stated, but they felt it wiser to proceed with caution for the time being until sufficient practical experience of engine operation at these high charging pressures has been acquired and evaluated.

The new engine series was designed on the basis of preliminary tests with a single cylinder unit of 760 mm (29.92 in.) bore plus further experience with test engines which have been operating in vessels for more than two years. It is interesting to note that Sulzer proposals were published as long as 30 years ago for a 6-cylinder engine of exactly the same bore and stroke as this latest addition to the RD range. At that time, however, the rating would have been only 5400 bhp at 72 rpm compared with the 12,000 bhp of the new RD series of engines.

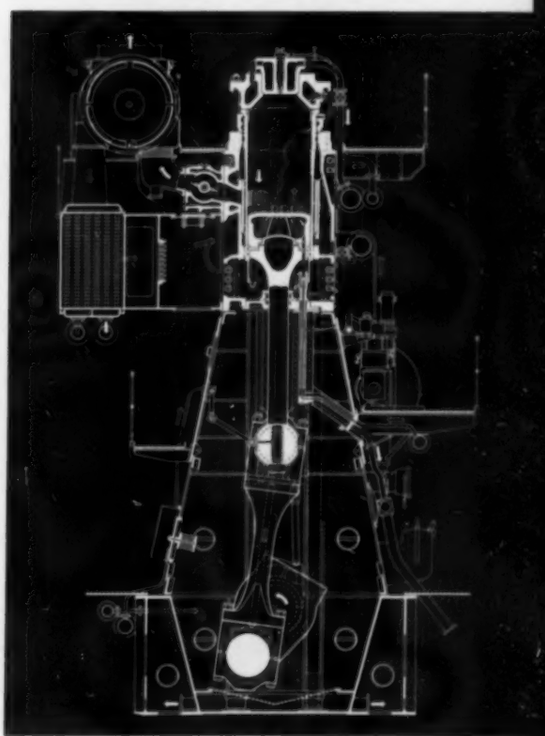
In the past half century Sulzer has incorporated many new features into their engines and these features are part of the RD designs. They include welded designs in conjunction with long tie-rods, fitting a partition between the crankcase and cylinders with the piston rod operating through a stuffing box, water cooling of pistons, injector nozzle tips and cylinders, burning of heavy fuel oils, enlargement of cylinder diameters and two-cycle turbocharging. One feature which has remained unchanged through this period is the cross head scavenging principle which was selected by Sulzer as the most satisfactory method back in 1910 and which has contributed to the simplicity of the engines built by the firm.

In a recent trial run, a Sulzer RD engine of 900 mm bore attained an output of 3000 bhp per cylinder. This output was reached at a speed of 130 rpm and a mean effective pressure of 10.5 kg/cm². Operating at this pressure and at an exhaust temperature of 380°C stipulated by the buyer, the fuel consumption was 155 grams/hp/hr. In the range from 6 to 7.5 kg/cm² the figure of 150 grams/hp/hr. was never exceeded. On these results, a 12-cylinder engine of the same type would be capable of an output of 36,000 hp.

The engine shown on the test bed at Winterthur is a 6-cylinder unit with a nominal output of 12,000 bhp and is equipped with two Sulzer turbochargers. It will be installed in the *Seine Lloyd*, a dry cargo vessel of 11,500 gross tons owned by Royal Rotterdam Lloyd. Over 140 orders for RD engines, including 16 of the RD90 units, totaling 540,000 hp were either under construction or had already been delivered by November 1, 1960.



Cross section of the Sulzer turbocharged and intercooled two stroke RD90 marine diesel.



SMALL GAS TURBINES TODAY AND TOMORROW

Here Are Excerpts from Dr. Schelp's Speech Presented Before the Petroleum Engineers Club of Dallas in Late 1960; Noteworthy Are His Observations on the Progress in the Design and Efficiency of Gas Turbines to 1500 HP

By DR. HELMUT SCHELP*

IT is not my intention to give you the past history of gas turbine development. I shall assume that you have a speaking knowledge as to how a gas turbine works. The over-all concept and the future development trend is more important, because it will have a greater impact on your business than will any spacecraft or any future journey to the moon.

Dr. Helmut Schelp

I shall confine myself to prime movers up to 1500 horsepower because larger installations follow different trends. In the past, when you inquired about gas turbines, mostly out of curiosity, it became apparent very quickly that the economy for 99 per cent of your applications was so low that it could not even be considered. The price was high, the fuel consumption high (roughly 1 pound per horsepower per hour), and the time between overhauls was short, but the size was also small. For most applications this size advantage did not compensate for the disadvantages by any stretch of the imagination. The compact, low-weight engines were for aircraft installations and were developed for aircraft applications.

However, recently you have heard stories and rumors about gas turbines having a fuel consumption of 0.6 to 0.7 lb./hp/hr. and an overhaul life of 5000 hrs. or more, and weighing only about one pound per horsepower. Gentlemen, these stories are facts, and this is only the beginning. Let us examine these trends more in detail. The designer of gas turbines has one more freedom, as compared with any other prime mover. He can design it for different applications. One will be a power plant with extreme compactness and low weight, but not the lowest fuel consumption. Such a design may be desirable for extreme portability. As an example, a 350 hp gas turbine is 20 ins. in dia., 45 ins. long, weighs 250 lbs., and has a fuel consumption of 0.65 lbs./hp/hr. per hour. The time between overhauls will be 2000 hrs.

If the weight and size are not such important factors, he can add a heat exchanger to recover the exhaust heat. The weight will go up from 250 to 450 lbs., but the fuel consumption will be decreased to 0.45 lbs./hp/hr. The design life will be 5000 hrs. between overhauls. Second-generation gas turbines with these performance data are not necessarily on the market today, but you will be able to buy them in the foreseeable future. These specific values cannot be scaled up or down indiscriminately. The smaller the engine, the higher the specific fuel consumption; the larger the engine, the lower this value will be. In addition, the presently accepted gas turbine has definite limitations as to size. It is my opinion that the lowest practical limit for such a gas turbine is 30 hp at the present time. I do not want to imply that the horsepower range from one to thirty is out of the question, but different design approaches have to be used. We are working on it, but it is too early to talk about it.

The gas turbine itself consists of four major components: the compressor, the combustion chamber, the expansion turbine, and the accessories and gearing. Since the compressor is already an integral part of the engine, this prime mover is extremely suitable to be used as an air compressor set. It is only necessary to increase the throughflow of the compressor which is driven by the expansion turbine in order to obtain compressed bleed air in large quantities. If the required air pressure is higher than the pressure ratio of the gas turbine, a combination compressed air and shaft output engine can be designed to meet the problem. The bleed air from the gas turbine is boosted to the desired pressure by utilizing available shaft horsepower to drive the boost compressor. In many cases the boost compressor can be driven at the speed of the turbine itself, which means that no reduction gearing is required.

For all applications where only shaft power is required, this prime mover again provides additional flexibility. It can be designed as a fixed-shaft engine to drive generators or similar equipment, or as a floating turbine for pump drives. The advantage of the floating turbine drive is that no clutch is required, and the torque characteristics of this engine are extremely favorable.

The more we become familiar with the gas turbine, the more we recognize that many more advantages can be obtained if we carefully analyze the needs of the driven equipment such as generators or pumps. A good illustration was provided in a recent advertisement for gas-turbine-driven pumps. In this case the pump alone weighs 10 times more than the turbine, and the gearbox weighs 2½ times as much as the prime mover. It is obvious that no optimum solution can be obtained if low-speed driven equipment designed originally to be driven by reciprocating engines must be used. It becomes even more apparent if you look at the presently available generator equipment—60-cycle generators are heavy. The low speed requires a large gearbox between the gas turbine and the generator, and the over-all configuration of such a set is not very attractive.

*Chief Engineer, The Garrett Corporation's AiResearch Manufacturing Division of Arizona

Operating on natural gas, this AiResearch gas turbine power unit acts as a supercharger for an engine-driven reciprocating compressor. Gas engine compressor-turbine combination substantially increased station capacity.

We are looking at a different solution. Today it is feasible to develop a-c generators to operate with the same speed as a gas turbine. Under those conditions, this generator will deliver a much higher frequency than the standard 60-cycle or 400-cycle generator. Let us assume that the output of the generator directly driven by the gas turbine is 3200 cycles per second. Today it is feasible, with the advent of silicon-controlled rectifiers, to develop a black box which converts the high frequency (in this example, 3200 cycles per second) to 400 cycles per second, to 60 cycles per second, or even to obtain variable frequency without changing the basic generator set equipment. Since this can be achieved, obviously a much greater reliability can be obtained from this type of equipment because of fewer parts, no gearing, and less complexity.

I want to caution that this type of equipment is not yet on the market. However, we have small generators of this type running at speeds as high as 48,000 rpm. The availability of such a piece of equipment will have a large impact on electric motors, because it is feasible to use a-c motors with variable frequency to obtain torque characteristics similar to those obtained from d-c electric motors. These are only a few examples of what is in store in the future and what will be available to you in the next decade.

As a potential operator of gas turbines you are not necessarily interested in the details of the specific values, because what counts is the total operating cost per hour or per horsepower. These costs are comprised of initial cost, fuel cost, maintenance cost, and overhaul cost. Before arriving at the over-all picture, it is necessary to investigate the increments separately to arrive at a trend.

The cost of such a prime mover is difficult to forecast because the horsepower range we are talking about can be successfully covered only if production methods are applied to result in a reasonable price. Large gas turbines are custom-made and can demand a premium price. The gas turbine up to 1500 hp has to compete with prime movers which are produced on a production or semi-production basis. You know that the dollars per horsepower vary with the size; however, as an example, we predict that a gas turbine with good fuel consumption in the 600-horsepower range can be produced for $20/hp on the basis of 1000 engines per year.

Let us ask the question, "What is the minimum fuel consumption for any prime mover?" Obviously, the lowest value would be obtained if the prime mover had an efficiency of 100 per cent. Then the fuel consumption would be 2545 Btu/hp/hr., or 0.137 lbs./hp/hr. if a fuel with the usual heat content of 18,500 Btu/lb. is being used. At the present time, 0.45 lbs./hp/hr. is a realistic value if size and weight are of no great significance. This prime mover would have a specific weight of roughly 1.3 lbs./hp. For any future planning, it is necessary to answer the question, "Which one will be the most efficient prime mover in the long run?" Interestingly enough, our answer is, "A Turbine." Before I tell you why, I have to mention that, based on available technology, the lower the specific fuel consumption, the higher the weight and larger the envelop. Today the most efficient prime mover we have found is a combination gas turbine and steam turbine cycle. The proven specific fuel consumption of such a cycle is below 0.3 lbs./hp/hr. When you realize that such a prime mover is readily adaptable to multifuel operation, you know what impact it will have on your business. Today an engine of this type is operating to produce 400 megawatts. Tomorrow it will be available for smaller sizes down to 1000 hp for fixed installations. This may come as a surprise to you, but these are facts which can be substantiated.

Editor's Note—Dr. Schelp's concluding comments were directed to maintenance and overhaul costs of gas turbines, an area where limited information is currently available. In general, he reaffirmed industry's position for equipment with absolute minimum maintenance costs and anticipated advances in overhaul procedures. In doing so, he pointed to AiResearch's development work on a 300 kilowatt turbine generator set for space application which in the end has to operate without maintenance for three years.

Garrett lightweight Fly-A-Way turbine unit goes aboard TWA 707 in Rome, Italy.

MISSILE BASE MAINTENANCE TRAINING STRESSES EBULLIENT COOLING

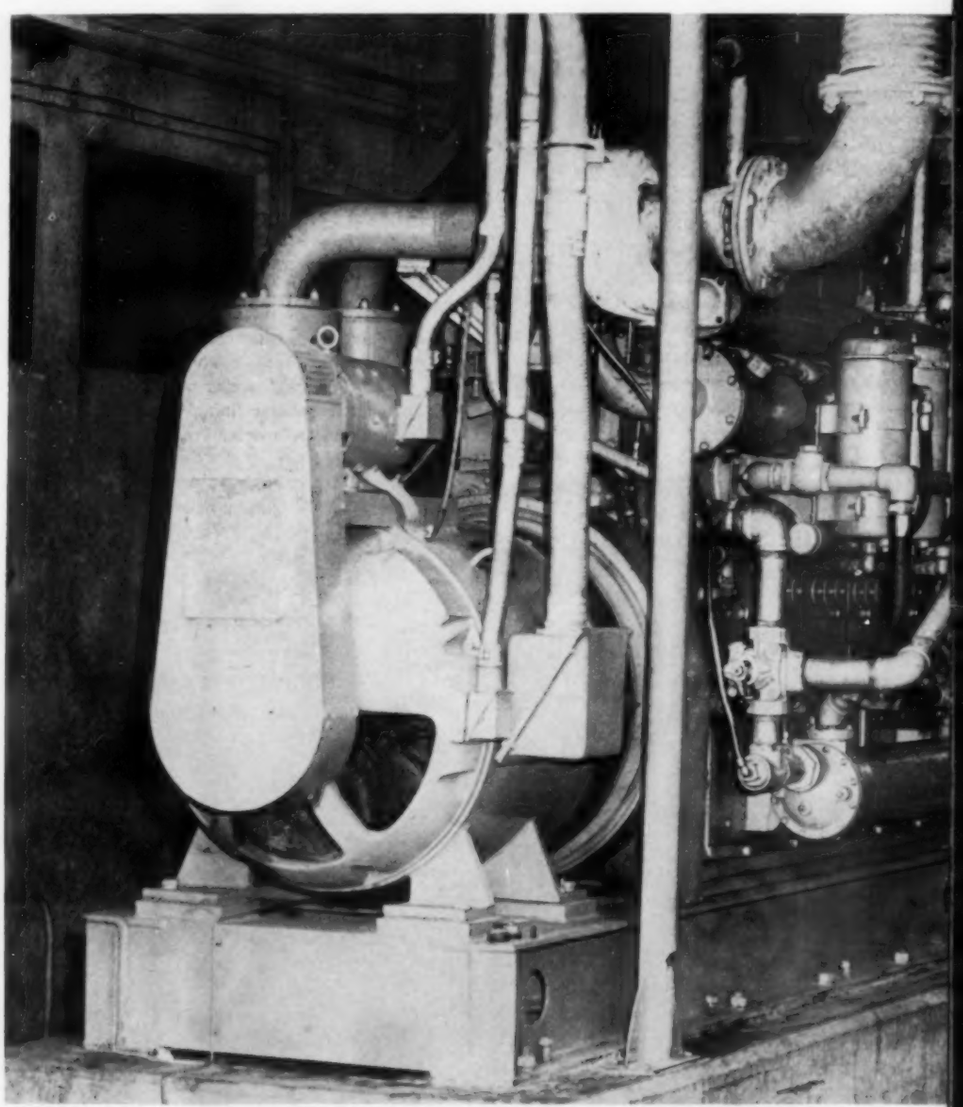
THE "wild blue yonder" of the modern Air Force extends around the world, high in the sky, below the ground—and inside diesel engines. Missile programs have thrust the Air Force into fields of changing technology, now more than ever before, not only in weapons but also in direct support of missiles such as the Atlas, Titan, Bomarc and Thor. Airmen are being taught the characteristics of exotic fuels. They also are learning about diesel engines and the process of ebullient cooling that is utilized at most Titan and Atlas missile bases.

Less than three years ago, the Department of Utilities Training was organized at Sheppard Air Force Base in Wichita Falls, Texas. Seventeen technical training personnel were transferred into the new department, and students followed immediately after the instructors themselves had digested the information necessary to maintain a missile base. In what was called a "major milestone" by Brig. Gen. Thomas E. Moore, commander of Sheppard Technical Training Center, the department recently honored its 5,000th graduate. According to Capt. Theodore Cline, head of the department, many of the 5,000 students were instructed simultaneously with the development of equipment that they would be expected to maintain in the field. Almost in the shadow of training missiles pointed skyward and a few hundred yards from B-52 bombers poised on runways as an operational wing of the Strategic Air Command, airmen learn how to disassemble, repair and re-assemble diesel engines. Stringent requirements must be met.

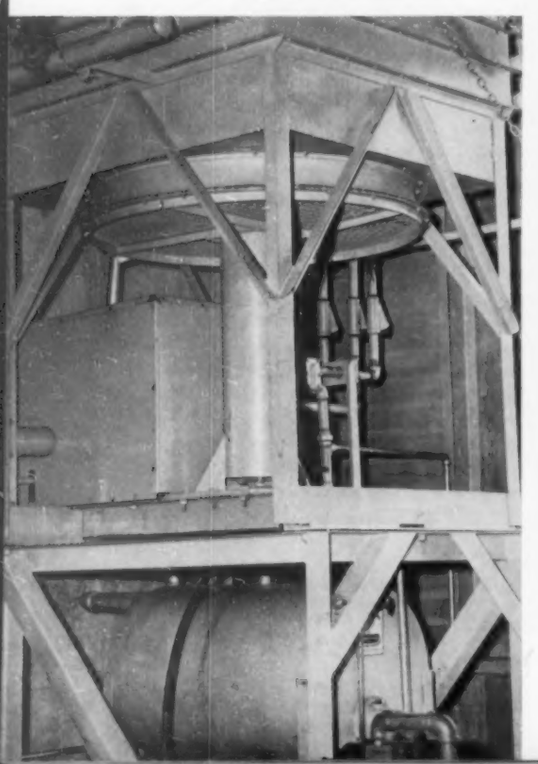
A process that only recently has attracted widespread industrial attention, ebullient cooling is an important part of the instruction for students who will be assigned to Titan or Atlas missile bases. As utilized at these sites, the process of cooling diesel engines by means of a boiling heat-transfer medium achieves much more than its prime objective. The vapor also heats the entire facility, including domestic hot water, and meets any heat requirements for refrigeration.

"Vapor Phase cooling eliminates all other heating at a missile site," according to Capt. Henry W. Poos, head of the Electric Power Production training branch. "This is like picking up something for nothing. The vapor is heat energy that otherwise would be dissipated."

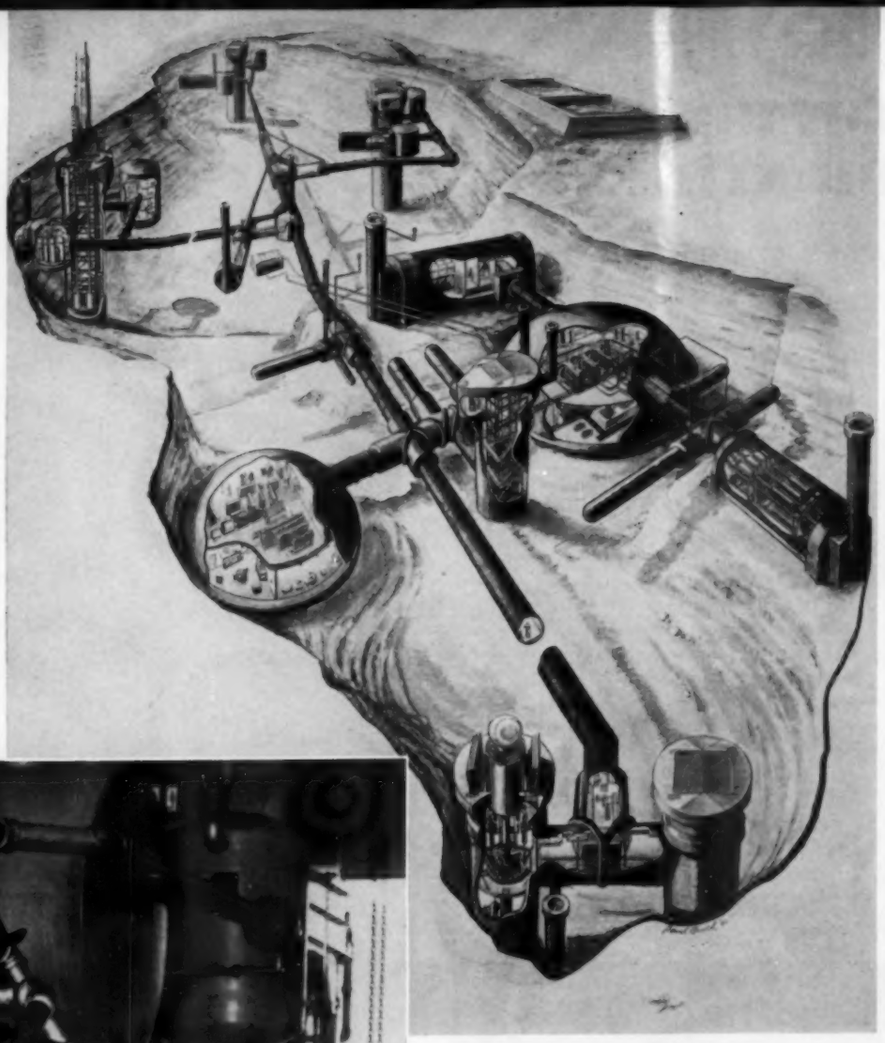
The Air Force first used ebullient cooling at DEW Line bases in the Aleutian Islands. The process eliminated the necessity of installing steam boilers, held down the size of the installation and saved shipping costs on fuel and equipment. These same factors have influenced the Air Force in its specifications for missile bases. Also, the fact that these bases are underground increases the need for avoiding a bulky installation.



A 361 hp White Superior model 40-SX-6 diesel engine equipped for ebullient cooling drives a 250 kw generator at the Air Force's Sheppard Technical Training Center at Wichita Falls, Tex.



View of the Vapor Phase condenser where the ebullient coolant is returned to liquid and put back into the cooling system. At missile bases the vapor returns here only after it has circulated as the facility's sole heat source.



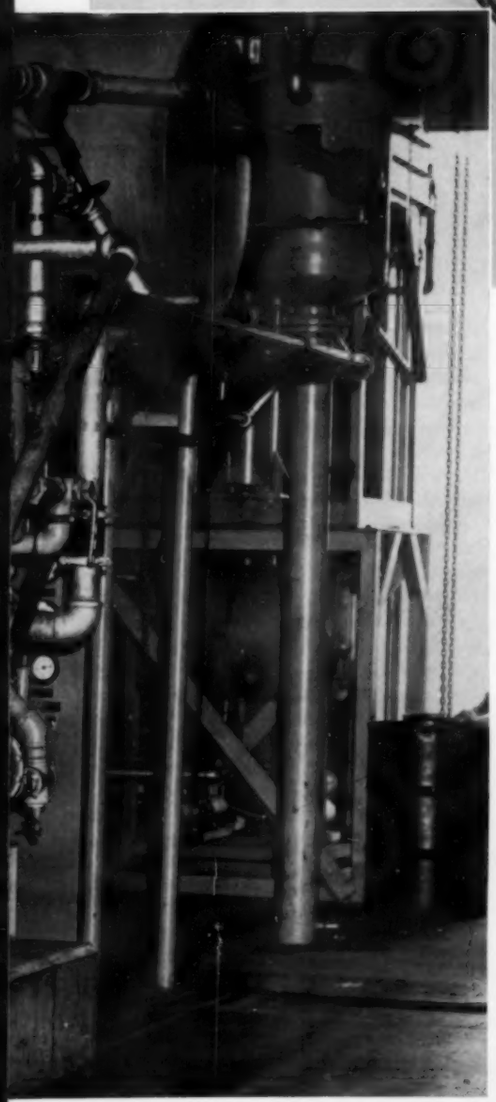
Cutaway drawing of a Titan missile base. At most Titan bases, heat for the entire facility is produced by vapor resulting from ebullient cooling of the diesel engines (in domed structure at right).

Prior to 1958, when The Dow Chemical Co. introduced Dowtherm 209 as an ebullient coolant, three materials—water, ethylene glycol and methanol—were commonly used for this process, but had serious disadvantages. Water posed the threat of freezing. Ethylene glycol prevented freezing in the engine block but, since it does not azeotrope with water, freezing still was a problem in separators, condensers and related piping. Methanol has a high vapor pressure that gives high vapor losses, causing poor heat-transfer efficiency.

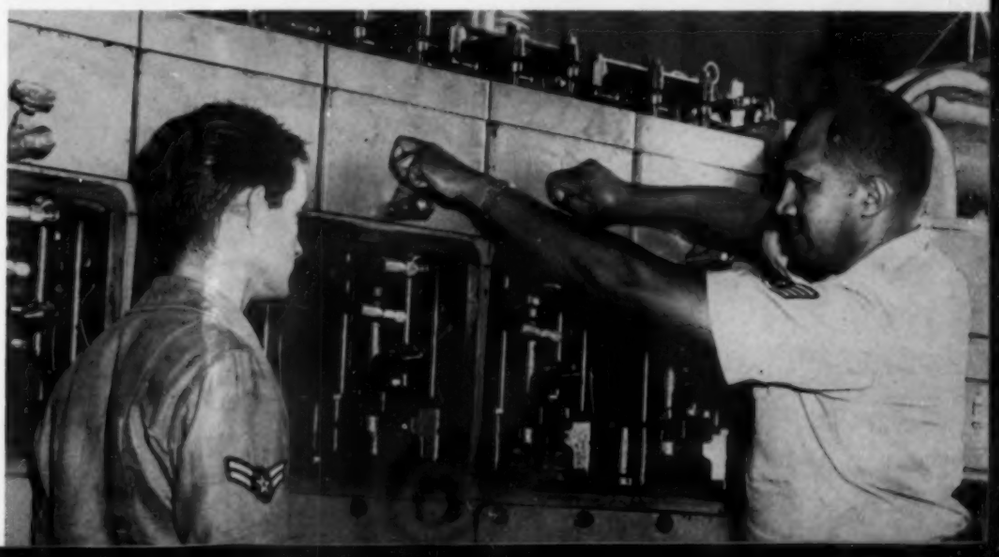
The Air Force mixes Dowtherm 209 with water on about a fifty-fifty basis and runs the engines at 240° F. with the coolant under 12 pounds of pressure. "So long as a load is kept on the engine, it won't move off that 240° mark in six weeks," remarked Capt. Poos. According to Dow, in addition to fulfilling the heating function, ebullient cooling offers these advantages: more uniform heating of the cylinder wall, faster engine warmup, automatic circulation and temperature control of the coolant, elimination of the water pump, reduction of corrosion and lubricant contamination and the possibility of using cheaper fuels.

Weather conditions present no problems for Dowtherm 209 since pour points range from –18° F. for a 40 weight per cent solution to –80° F. for one of 60 weight per cent. This product when mixed with water in the concentration range of 40 to 60 per cent forms an azeotropic (constant boiling) mixture with an atmospheric boiling point of 209° F. The azeotropic mixture, once formed, cannot be separated by boiling; thus, the vapor composition will always be exactly the same as the bulk fluid. Because of this unusual property freezing protection is obtained throughout the system.

At Sheppard, instruction in ebullient cooling is carried out with actual experience on four White Superior diesel model 40-SX-6, 361-horsepower, 250-kilowatt diesel engines equipped with Vapor Phase cooling system.



The ebullient system has many characteristics of a low-pressure, water-tube boiler. Ordinarily no pump is used; rather, coolant circulation is by natural convection, or thermosiphoning. Circulation does not start until the coolant reaches the boiling point. At the missile bases, the vapors are piped from the diesel engine through the base to provide heat. The condensate from the heating system and from a standby condenser is returned to the cooling system. The system is entirely closed and little or no makeup is needed for cooling formulation, except in the event of an emergency it can be vented to the atmosphere through safety valves and obtain sufficient operating time to complete the mission assigned to the station.



Diesel maintenance instruction is given at the Sheppard Technical Training Center. Here Staff Sgt. Joseph Mack instructs Airman 2/C J. L. Robertson.

PIPELINE COMPRESSORS CONVERTED FOR STRIPPING

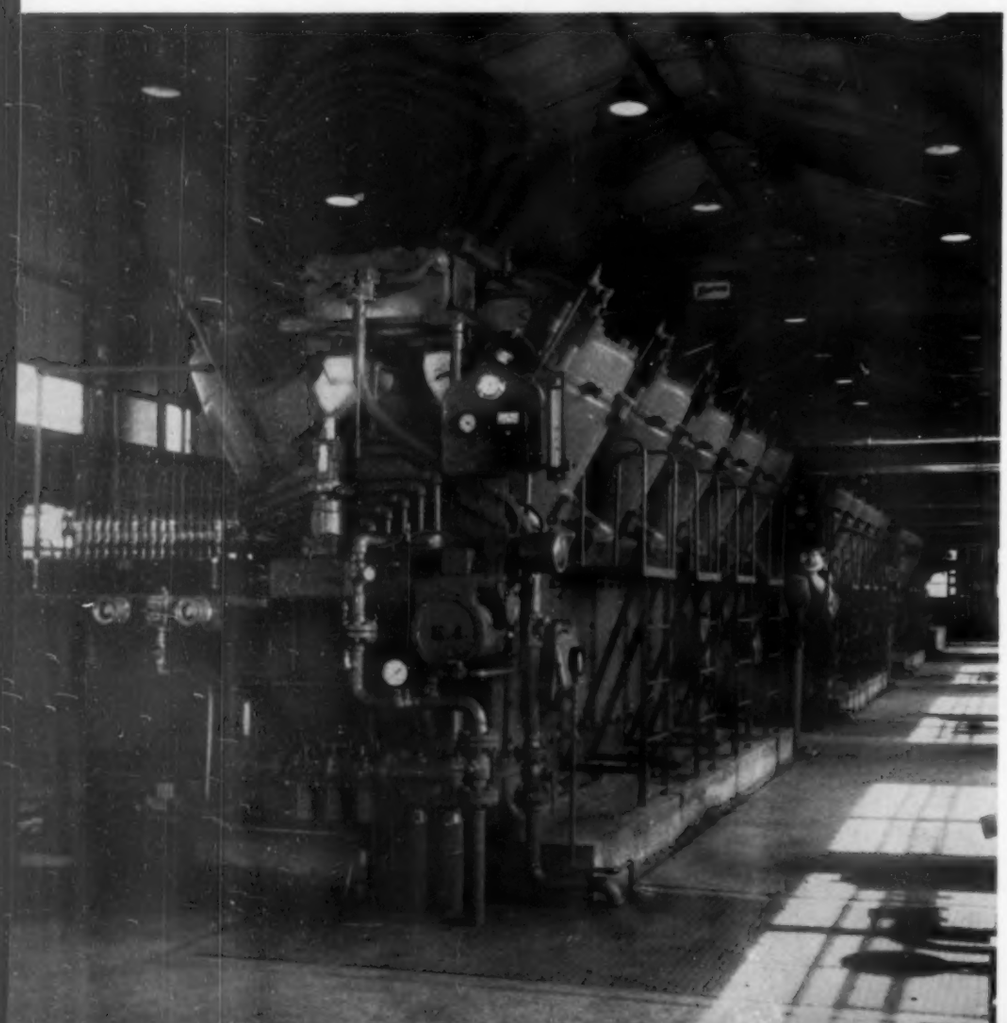
By ELTON STERRETT

THREE power plants instead of one. Dispersal instead of concentration. The Rayne, La., natural gas processing plant of the La Gloria Oil & Gas Co., a subsidiary of Texas Eastern Transmission Corp., includes three buildings each housing two or more gas engines, and sharing in common only the jacket water cooling system and, because of fail-safe protection, the shift operators. Processing about 175 million cu. ft. of natural gas per day (mmcf) at the pressures and conditions encountered in the Rayne field required installation of 6784 brake horsepower, in nine units, in ratings ranging from 1100 down to 408 hp.

Texas Eastern Transmission originally operated the war emergency 20 in. pipeline as a natural gas carrier. When they decided to convert that trunk line to petroleum products (liquid) the compressors originally installed on the 20 in. when fitted for natural gas transmission became surplus, since the power and compressor cylinders were built into one unit, and the prime mover portion could not be used for driving centrifugal pumps on the liquid line.

Four of these engine-compressor units were transferred to the new plant: one an Ingersoll-Rand model KVG 10-cylinder unit, rated 1000 bhp at 330 rpm; two Cooper-Bessemer model GMV 10-cylinder engines, rated 1100 bhp at 300 rpm; and one Cooper-Bessemer model GMV 10-cylinder engine rated 1000 at 300 rpm. Extensive revision of compression cylinder equipment was required. Extracting hydrocarbon liquids from the natural gas stream requires recompression for gas emerging from flash operations, as well as to that coming off the still. Added to these two gas streams destined for eventual delivery as either pipeline gas, plant fuel or condensed hydrocarbons, is extensive need for refrigeration at various steps in the process. This refrigeration is furnished by propane refrigerant vapors, recompression of which absorbs almost one-half of the power from the four engine-compressor units equipped for this duty.

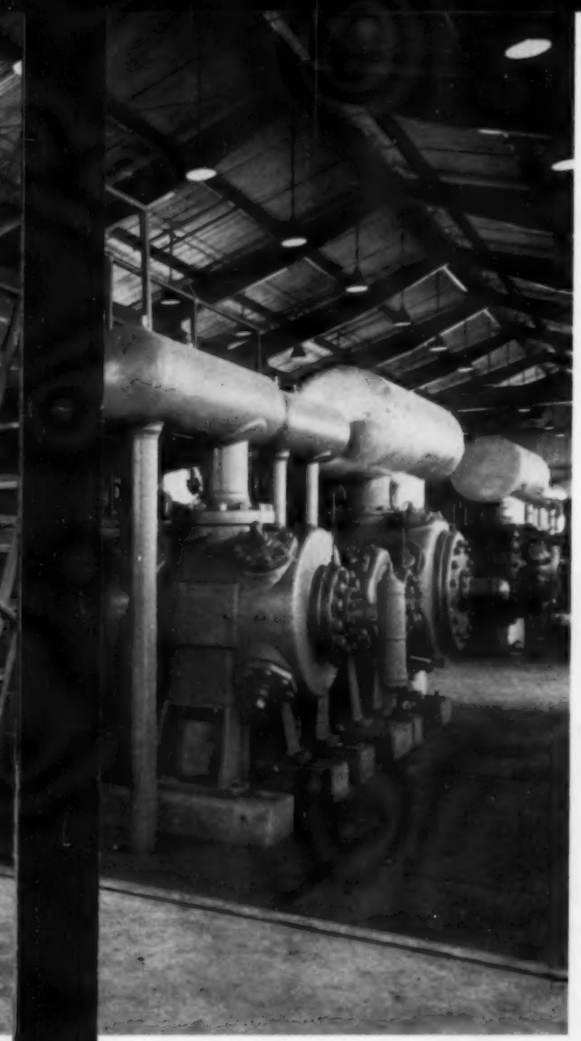
Compressor room, engine side, showing the three Cooper-Bessemer GMV 10 cylinder engine-compressors, two rated 1100 bhp, the third 1000 bhp. The two-cycle GMV has 14 in. bore and stroke.



The building for this compression service houses in a single row the four V-type compressor units. Their capacity is such that any three of the engines will carry the plant load, leaving the fourth for stand-by. Each unit is equipped with one first-stage recompression cylinder, all of equal volume. The same is true of the second-stage recompression cylinder, both these cylinders being employed in two-stage recompression of the flash gases. Each 1100 hp Cooper-Bessemer is likewise fitted with a fixed capacity still product compression cylinder, and each designed to carry one half of the daily load of that gas. The 1000 hp Cooper-Bessemer carries a like cylinder, but equipped with valve lifters at both head and crank ends. Thus two of these three will carry the plant requirements for this service. There is no still product cylinder on the 1000 hp Ingersoll-Rand.

The propane refrigerant compression service is carried on one cylinder on each of the four prime movers, each adapted to share the load to allow for one of the four being out of service and yet provide adequate coolant.

Both 1100 hp Cooper-Bessemers and the 1000 hp Ingersoll-Rand are fitted with fixed capacity cylinders for this service, while the 1000 hp Cooper-Bessemer cylinder for refrigerant has a fixed clearance pocket. When this unit is being operated with the two 1100 hp units, it is relieved of its portion of the still product compression—as the



Ingersoll-Rand model KVG, 10 cylinder, 1100 bhp engine-compressors. The nearer cylinders and volume chambers are for gas recompression, the third, with lagging insulation is part of the refrigeration system.

Design of the lean oil pumping equipment is such than when operating at 93.5 per cent of their rated speed (or 3778 rpm) the total lean oil pressured through both pumps is sufficient, at design oil-to-gas ratio, to treat 170 million cu. ft. per day of residue gas through the absorbers.

The plant requires 30 pumps, in addition to the two lean oil units. Twenty-seven of these are electric motor driven, the other three by Ingersoll-Rand hydraulic turbines powered with rich oil from the absorbers. This power generation—or, more correctly, saving—is effected while dropping the rich oil pressure from 1235 psig to 540 psig, and utilizes this pressure drop in driving the 105 bhp turbines. A third turbine, rated at 80 bhp, utilizes the pressure drop from 525 psig to 210 psig between flash tanks.

Other than the energy recovered from the oil streams as their pressures are lowered during the processing operation, electric power is required to drive the 27 pumps, motors ranging from 10 to 100 hp and totalling 1275 hp. Two additional motors are used to turn the fans in the enclosed jacket water cooling unit. Added to this motor load is that for lighting the plant for 24-hour operation. To meet this current demand are three Electric Machinery 3-phase, 480-volt, 60-cycle generators, each rated at 280 kw and each direct-connected to an Ingersoll-Rand 6-cylinder model PSVG engine rated 408 hp at 514 rpm. As with other power units throughout the plant, two of these units will carry the entire lighting and power load, leaving the third as stand-by.

Lube oil make-up to all engines is automatic. Each crankcase is equipped with a level-controlled valve which draws oil from a pressurized supply system. Full flow filtration and temperature control of the oil returned to the engine from the oil cooler are incorporated in the closed lubrication system with which each engine is equipped. The same lube oil is provided for all engines.

All engines are fueled with what might be termed a by-product of the processing of natural gas. In the separation of hydrocarbon fluids and the recovery of gases suitable for pipeline transmission, there are recovered fractions in the range above the ethanes, and which are commercially non-condensable. These are collected as they are separated from the natural gas processing, cooled, and used as plant fuel.

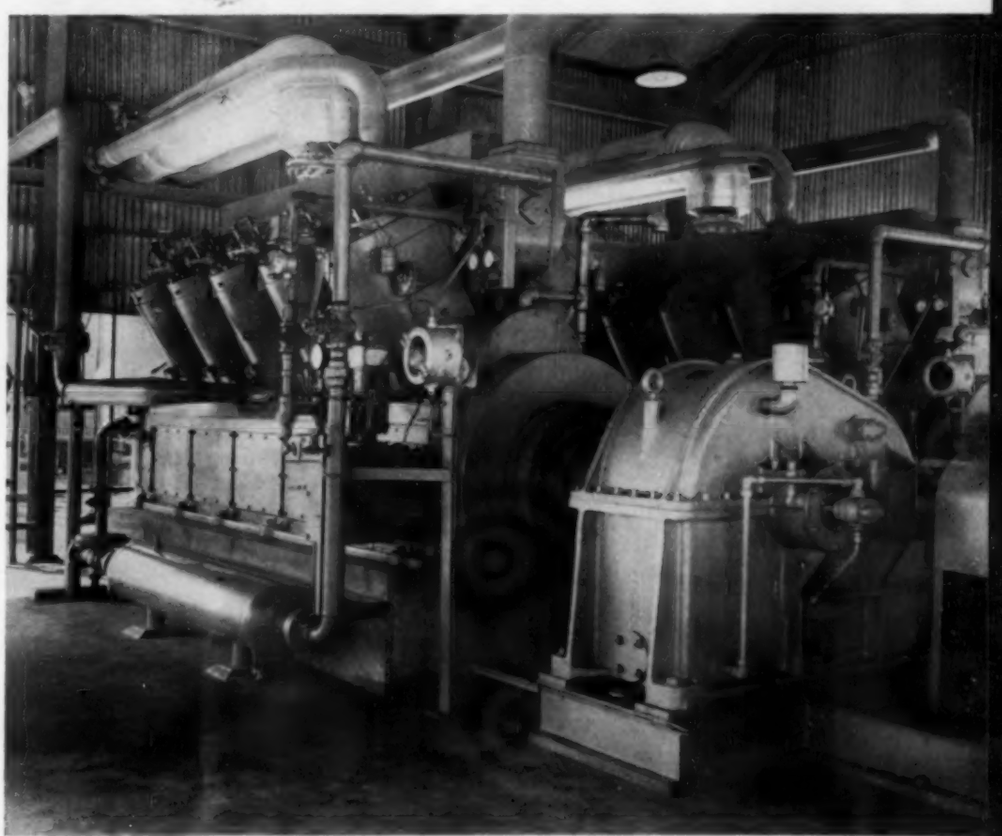
The jacket cooling water from all three buildings is pumped to a centrally located finned tube cooling unit having four bays in two sets, each with individual fan and geared electric motor drive. Water from the cooling unit is distributed to the various engines, with by-pass temperature control of the water being returned.

Steel buildings, closely grouped but widely enough separated for isolation in case of fire in another, house the power plants. The two serving as compressor and generator houses are fully insulated and enclosed; being equipped with space heaters

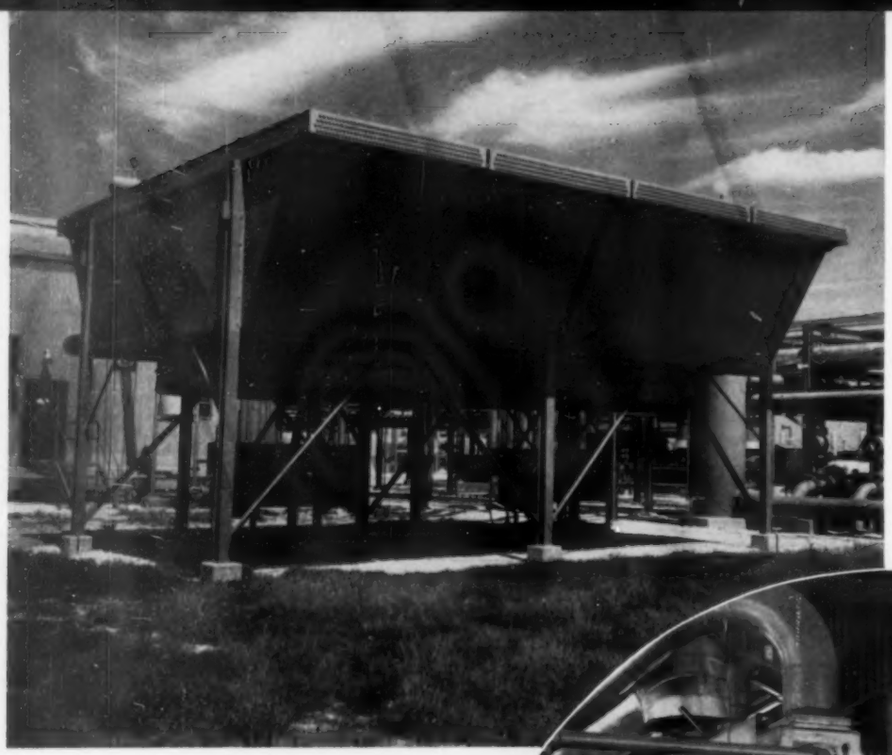
two larger engines are each designed to handle one-half this load. When operating under this set-up, the 1000 hp unit's still product cylinder is unloaded with the valve lifters and the propane cylinder clearance pocket is closed to load the unit.

When the operating program involves one 1100 hp Cooper-Bessemer, the 1000 hp Cooper-Bessemer and the 1000 hp Ingersoll-Rand, it is necessary to provide for dividing the still product load between the two engines in that series equipped to carry it. This is accomplished by loading the still product cylinder on the 1000 hp Cooper-Bessemer and operating the propane refrigerant cylinder with its clearance pocket open so as not to overload the engine.

Lean oil for the absorbers, which operate at 1235 psig, is pumped with two Ingersoll-Rand nine-stage centrifugal pumps, each delivering 597 gpm at 4030 rpm. These pumps are driven through Philadelphia type AIS size 21 speed increasers with a ratio of 7.85:1 by two Ingersoll-Rand model PSVG 10 cylinder engines, rated 680 bhp at 514 rpm.



Two 680 bhp Ingersoll-Rand engines driving lean oil pumps through Philadelphia speed increasers. Volume chamber at engine base provides smooth gas flow to governor inlet valve. Mercoid unit on post sets air-operated release to speed other unit in case of stoppage of its companion.



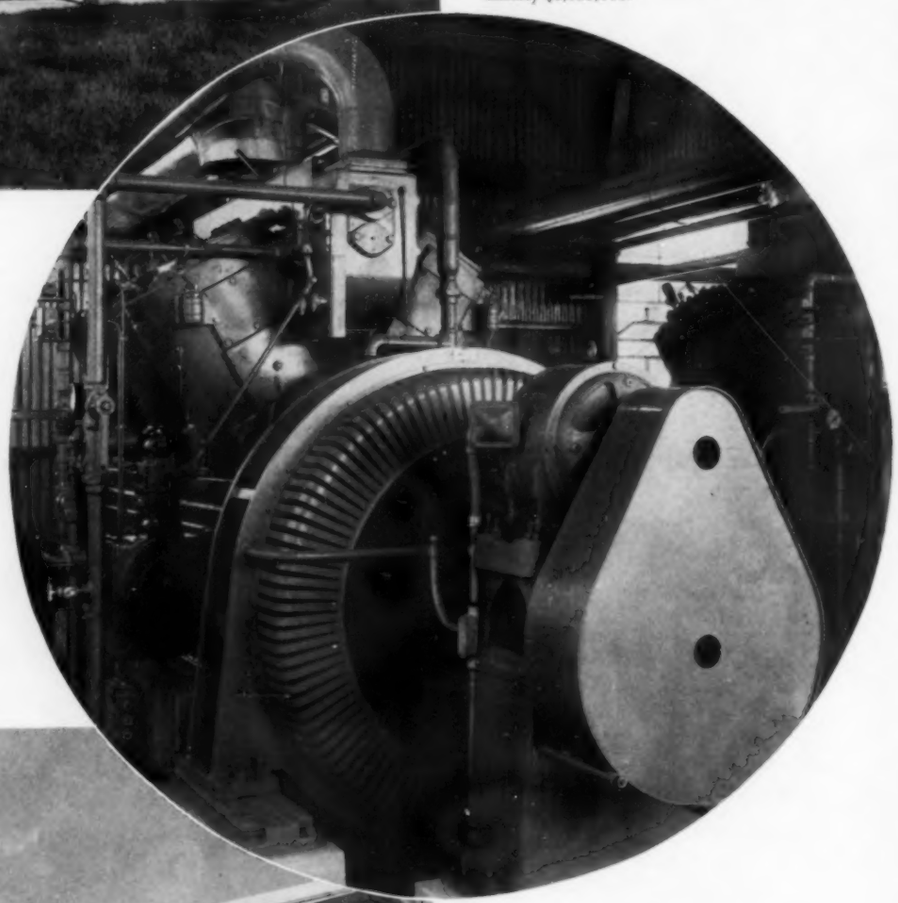
Two-bay, four unit Cycoil finned tube jacket water cooling unit. Vertical motors drive the fans through multiple V-belts at speeds controlled by temperature differential.

whistle signals malfunction in the engine department; while lights on the control panel in the area indicate the source of the alarm. A companion light above each engine building also indicates in which structure the trouble spot has occurred. Alarms are actuated by, among others, high levels in the compressor suction scrubbers, fuel gas scrubber, stoppage of a compressor, generator, lean oil pump or instrument air compressor.

The plant, which began operation on June 27, 1960, was designed by Brown & Root, Inc., of Houston, who also acted as contractor for the construction. Total cost of the plant is approximately $3,855,000.

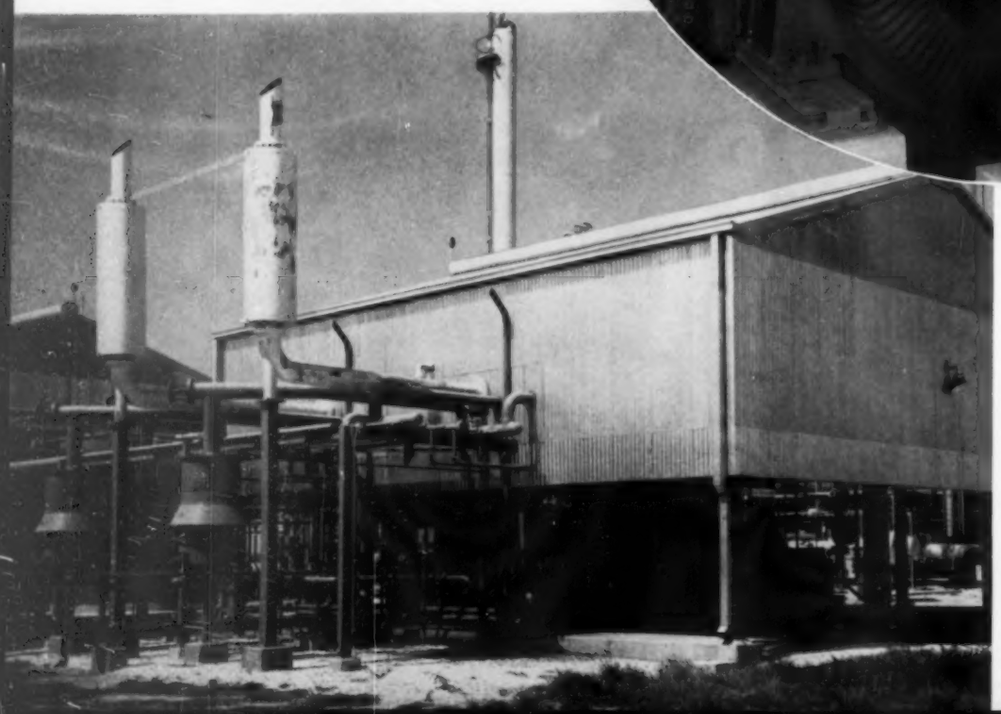
for maintaining desired floor-level temperatures during the winter. The lean oil pump building has full room, and is enclosed on all sides with curtain walls which extend downward from the eaves to a level some six feet above the concrete floor. This provides ventilation in case of a leak in the high-pressure oil system.

The alarm system to warn of upsets in operating conditions has both audible and visible signals. A



One of three engine-generator sets providing electric power for the plant. The Electric Machinery 280 kw generator is direct driven by the model PSVG engine rated 408 hp at 514 rpm.

Maxim exhaust mufflers, American Cycoil air cleaners on the engine side of lean oil pump room. Heat exchangers for fuel gas are mounted horizontally at pier top level. Abbreviated skirt walls are for ventilation of area.



Principal Equipment

Engine-compressors	Cooper-Bessemer; Ingersoll-Rand
Engines, (generators)	Ingersoll-Rand
Generators	Electric Machinery
Speed increasers	Philadelphia
Governors	Woodward, Pickering
Ignition system	American Bosch, Bendix
Air cleaners	American Air Filter
Lube oil filters	Hilliard
Lubricators	Manzel, McCord
Pyrometers	Alnor
Mufflers	Maxim
Pressure, level controls	Mercoid

DIESEL FUEL PUMP MARKETING PROGRAM IS ANNOUNCED

Agreement Between Bendix-Scintilla, Simms Motors is Announced at SAE Detroit Meeting

ONE of the important developments of the SAE Annual Meeting in Detroit was the announced agreement whereby the Scintilla Division of the Bendix Corp. will market and manufacture diesel fuel injection equipment of Simms Motors Units, Ltd. of England in the United States. The Scintilla Division in addition has non-exclusive rights in Canada, Mexico and Brazil.

Included in the agreement are the Simms A, BZ, BN B size pumps, the newer MiniMec, MiniVac, and MiniPump, the Simms range of CR fuel pump couplings, and fuel oil filters. With this broadened product line, the Scintilla Division will serve the small and medium sized diesels for which Simms pumps are built, as well as the larger diesels and gas engines utilizing Bendix single cylinder pumps or ignition systems. In his announcement George E. Steiner, general manager of the Scintilla Division, emphasized that Simms equipment has application in all major areas of diesel activity—on highway, off-highway, oil fields, marine, etc. It is currently being used by such British engine manufacturers as Rolls-Royce, Paxman, BMC, Leyland, Dorman, General Motors-Bedford, and Ford of England. It is also used in the United States on Ford Motor Co. diesel farm tractors.

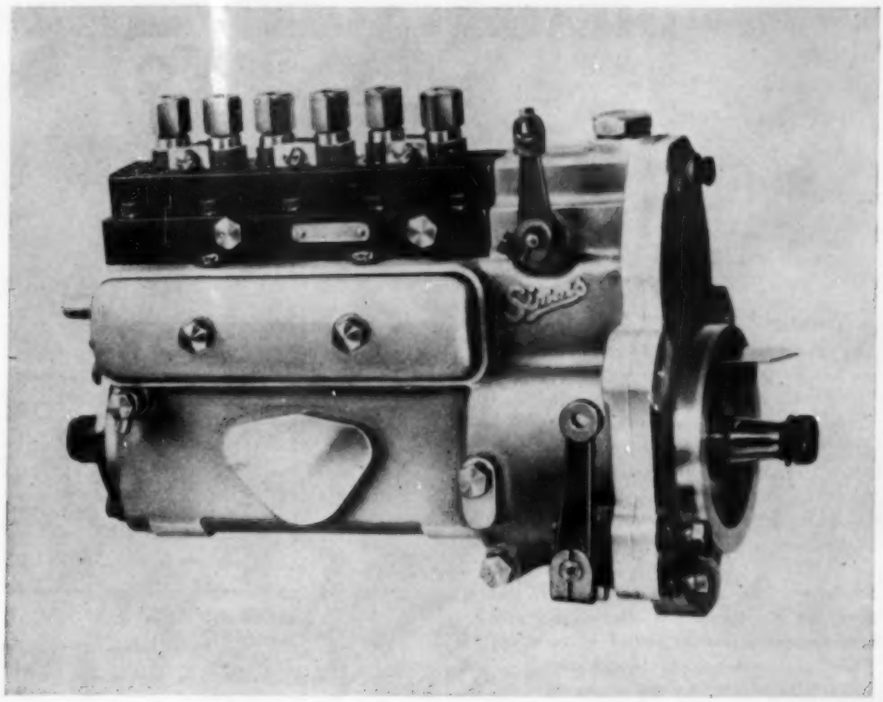
J. T. Davidson

Ted Watson

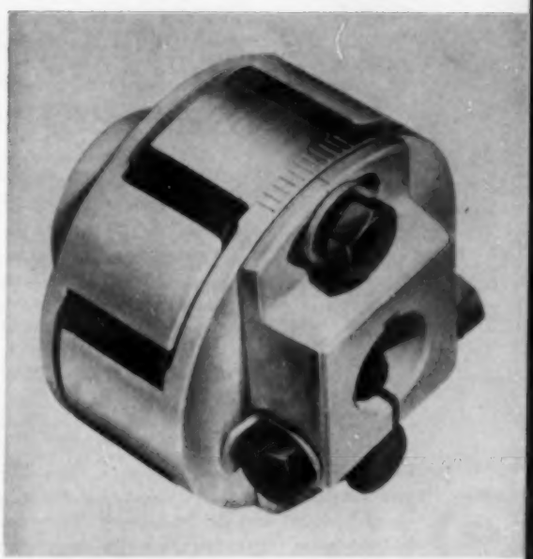
On hand for the announcement in Detroit was the technical director of Simms, Mr. C. H. Bradbury and the company's commercial director, Wilfrid Newland. These men, meeting with John T. Davidson, product sales manager, Ted Watson, chief engineer and other members of the Scintilla Division organization, discussed the engineering and sales relationship between the two companies. As established, the Sidney plant will have the responsibility for all manufacturers sales, plus coordination of the parts and service program through the same distributor and service centrals now handling Bendix fuel injection equipment.

Simms fuel pumps are all presently manufactured in the in-line type, approximately 200,000 sets being produced annually. The high production in England by Simms and other fuel injection equipment manufacturers reflects the heavy dieselization in that country where in the first six months of 1960, 96 per cent of all tractors were diesel equipped. Also, of the 160,000 commercial vehicles produced in 1959, 76 per cent were diesel.

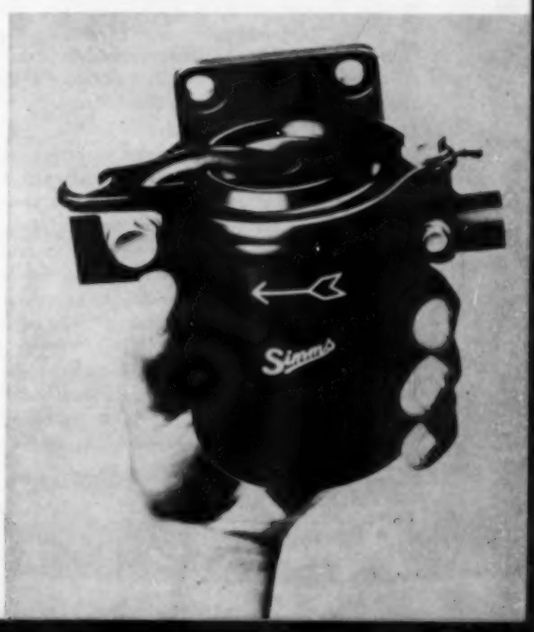
The newest pump in the Simms line is the MiniMec in which the mechanical governor is an integral part of the pump. Also, the MiniPump is designed so that it can be fitted with either the mechanical or vacuum type governor. The MiniMec will be available in 2, 3, 4, 5, 6 and 8 cylinder models for either two or four cycle engines. The MiniPump is designed for engines up to 90 cu. in./cylinder. Engine speed on four-cycle applications ranges to 3200 rpm, and on two-cycle to 2500 rpm. One of the features of the pump, outside of its small size, is an excess fuel device which provides extra fuel for starting.



MiniMec fuel pump is newest in Simms' line. Mechanical governor is integral part of pump. MiniMec will be built for engines from two to eight cylinders in two or four cycle models.



Simms CR33 coupling is among other products included in sales agreement with Bendix Scintilla Division.



Bendix Corp. Scintilla Division will also market Simms' fuel oil filters.

DIESEL ENGINE VALVE TRENDS

By JAMES M. CHERRIE*

POPPET type exhaust valves are one of the critical components in a diesel engine. Despite the adverse environment in which they operate, they provide a high degree of reliability. In normal operation, valves are subjected to elevated temperatures, high mechanical stresses and severe attack by corrosion and oxidation. To supply a satisfactory part under these conditions, product development is continuous to take advantage of metallurgical advances and new processing methods.

Several years ago a field survey indicated that in a number of cases exhaust valve failures were responsible for premature engine maintenance. In Figure 1, a breakdown of the failure types found is shown. Valve breakage, the predominant failure, originated from two separate causes. Fatigue and/or impact failures occurred on the valve head, resulting in the loss of chordal segments. Surface stress risers such as nicks, scratches and corrosion pits act as a nuclei for this failure.

J. M. Cherrie

The second breakage type failure encountered was radial cracking commonly identified as thermal fatigue. Radial cracks originate at the head O.D. or the seating surface and progress toward the head center line. These actually are tensile failures with adjacent particles of material being pulled apart. The cracking progresses into the head to the point where the increased cross section sustains the applied stress. They then turn normal to the original path and follow a circular path around the head center. When two isolated cracks interconnect, a wedge shaped segment is dropped from the head.

Once these field data were recognized, the Valve Division of Thompson Ramo Wooldridge Inc., Cleveland, Ohio embarked on a development program to find more useful materials from a structural standpoint and with greater resistance to radial cracking. In Figure 2, stress elongation data are shown for the materials in use at that time and also the improved materials later released. A laboratory bench test was developed to rate materials in terms of their relative resistance to radial cracking. The tests are conducted by mounting a valve in a fixture built like a typical installation. In a cycle test, the valve is alternately raised into an induction coil and heated, then rapidly closed onto a water cooled seat. The thermal cycle is severe with failures produced in a few hours. Tests run on the new materials indicated a greater resistance to radial cracking. Field experience later verified the rating order and the relative improvement between materials.

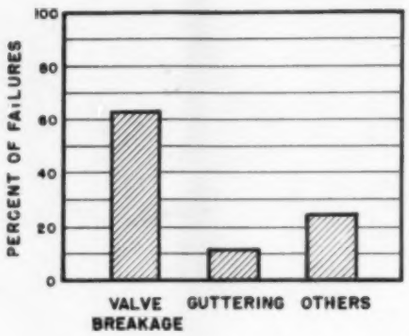
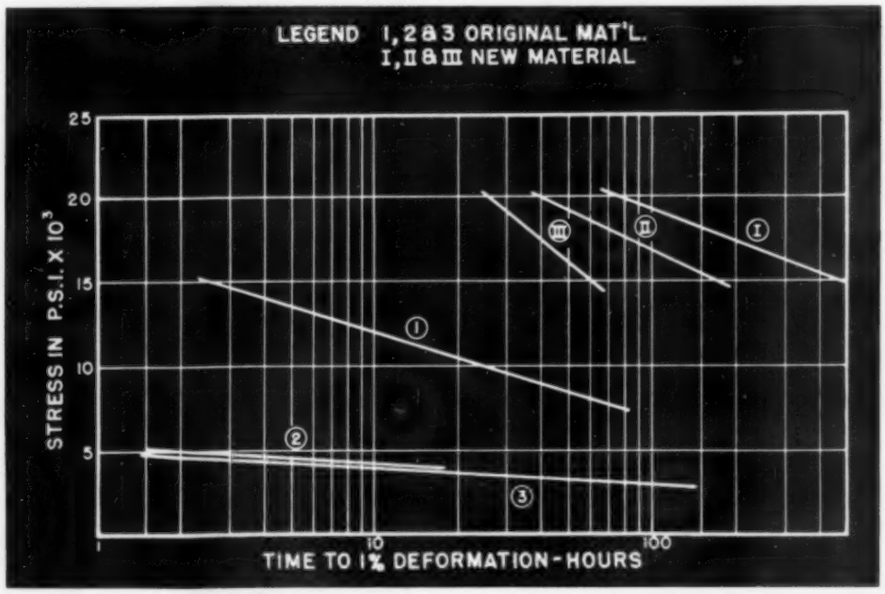


Figure 1. Exhaust valve field failures.

Considerable development work had been done on materials applicable to gasoline engines, thus the alloys available were designed for corrosion and oxidation resistance and high mechanical properties. It was found generally that materials with excellent corrosion resistance in gasoline engines did not afford similar protection when attacked by the constituents present in diesel fuels. In diesel engines, the valve requirements are quite different. The fuel contains no lead, but sulphur and other metallic salts or oxides act as corrodents. To insure complete fuel utilization, the engine requires large amounts of excess air increasing the oxidation attack. Fatigue life becomes increasingly important with engines running for long time intervals between overhaul. After an extensive testing program, a series of high hot strength fully austenitic wrought alloys were proposed and almost immediately put into production.

A current field survey, shown in Figure 3, indicates a decided change in the failure type. Despite a continuous engine rerating program, resulting in increased engine speeds, displacement and Bmep, the materials originally proposed still provide adequate structural strength. The remaining valve problem most prevalent today is face burning or guttering. A large percentage of these failures result from deposit channeling across the valve face. In normal operation, heavy brittle deposit layers form on the valve face. In time, the deposition chips off opening a channel through the seating surface permitting the escape of hot high velocity gases. Once blowby occurs, the failure follows in a limited number of cycles. Under these conditions, the temperature and oxidation requirements are so severe that no discernible differ-

Figure 2. Valve steel stress elongation curves.



Mr. Cherrie is manager-product engineering for the Valve division of Thompson Ramo Wooldridge, has contributed a number of technical articles on valve train parts and holds several patents relating to fabrication and processing of poppet valves.

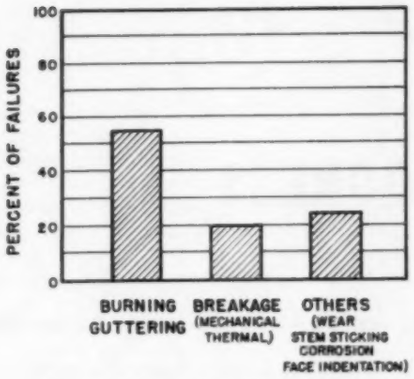


Figure 3. Exhaust valve field failures today.

ence in time to burning is found between low alloy ferritic materials and highly alloyed austenitic valve materials.

A spectographic analysis of the ash-like deposit present on the valve faces indicates a high percentage of calcium, barium, zinc, phosphorus and traces of other metallic alloys. These metallic salts and oxides originate in part from the high additive content detergent type lubricating oils now in general use.

For satisfactory valve performance under these conditions, engine manufacturers can consider several steps within their control:

1. Minimize engine oil consumption to reduce the volume of oil available in the combustion chamber to form deposits.
2. Restrict the flow of lubricating oil to the valve. Supply an adequate amount with no excess. Any excess oil is potentially available to increase the deposit level.
3. Select the proper type of lubricating oil. Certain engines operating under severe conditions with low grade fuels require highly additive detergent type lubricating oils. In less severe applications, lower detergent level lubricating oils, with reduced ash forming potential should be considered.

Once this problem gains more recognition, we believe that several logical steps will be taken to provide a solution. First, a new series of ashless lubricating oils is appearing for light duty general automobile use. Further development of this program could provide a reduced ash content heavy duty lubricant. Second, lubricating oil consumption increases exponenetially with respect to engine output. Manufacturers marketing highly developed turbocharged engines will find improved means of reducing oil consumption through improved piston and ring designs and cylinder blocks and heads incorporating increased rigidity. We believe that each of these steps must be undertaken before diesel engines can progress into their next stage of development.

References

A. H. Fox, R. A. Pejeau and Leonard Raymond, "Submarines, Snorkel and Sulfur" S.A.E. preprint No. 862 presented at the S.A.E. National Diesel Engine Meeting, Chicago, November, 1956.

Ethyl Technical Notes *"Diesel Fuel"* February, 1960.

J. A. Newton, J. L. Palmer and V. C. Reddy *"Factors Affecting Diesel Exhaust Valve Life"* S.A.E. Preprint No. 190 presented at the S.A.E. National Diesel Engine Meeting, Chicago, November, 1953.

DIESEL SERVICE PROGRESS

A COMMENTARY BY **GEORGE R. MACKEY**

George R. Mackey was long associated with Detroit Diesel Engine Division of General Motors Corp., and had prior experience as a mechanic in Europe and the U.S.A., which enabled him to become well acquainted in the diesel and service fields and to obtain a broad scope of the service industry from the customer's and management's viewpoint. Further training at Carnegie Tech and in the Army Ordnance during World War II provided the necessary requirements in planning service programs. Progressive advancement in diesel service areas in General Motors and with Detroit Diesel led to his position as Supervisor of Service Promotion. Upon termination of employment with General Motors in 1952, he joined Clayton Manufacturing Company, and his present position with this organization is Sales Manager of the Dynamometer Division.

Diesel Vs. Gasoline Engines

SINCE the conception of the diesel engine, it has gradually found its way into a great many applications where assured performance and operating economy are requisites. During the early developments the large size of most diesel engines limited their applications but the smaller, compact high speed engines of today have few application limitations. In fact, during the last few decades the diesel engine has become extremely popular in many fields heretofore handled exclusively by the gasoline engine. While there is a definite place in our modern mechanized world for both gasoline and diesel engines, more and more vehicle and equipment manufacturers, previously featuring only gasoline power, have either introduced new diesel powered models, or are offering diesel engines as an option. With this growing increase in the diesel engine's popularity, it might be worthwhile to consider what there is about the diesel which provides for universal application to so many industries, what makes it so desirable, and what makes it different from the gasoline engine so important to our daily living.

If two engines of equal size were placed side by side, one a diesel, the other a gasoline engine, they would bear many striking similarities. Both engines have cylinder blocks, heads, cylinders, pistons, connecting rods, crankshaft and valve mechanisms. But despite the many similarities, closer investigation will show many differences.

On the diesel engine we will not find the distributor, coil, spark plugs, wiring, carburetor, or other familiar components we see on the gasoline engine. Instead we will find a fuel pump, fuel lines and fuel injectors. On some types of diesels we may only notice the pump and fuel lines unless we remove the valve cover. On many diesel engines we might find blowers or superchargers. When we look further and visualize what takes place within the engines during their operation, we find the major differences between the two engines.

In the gasoline engine the fuel and air are mixed before they flow into the cylinder during the intake stroke. Theoretically we consider this mixture to be in a ratio of 15 parts air to 1 part of fuel. Actually the ratio will vary from about 11:1 to 14.5:1, depending on the operating conditions. In the diesel, air only is taken into the cylinder during the intake stroke, the actual mixing of air and fuel taking place inside the cylinder. During the compression stroke the carbureted gasoline engine compresses the mixture of air and volatile fuel. The compression ratio varies from 8:1 to 10:1, with a compression pressure in the vicinity of 140 psi, and compression temperature from 400° F. to 500° F. Because air only is in the diesel cylinder during the compression stroke, compression ratios of 13, 14, 16, and 18:1, or even higher, are quite common, with a resulting pressure of around 500 psi, and temperatures in the neighborhood of 900° F. to 1000° F.

It is the electric spark introduced to the combustion chamber of the gasoline engine, as the piston approaches top-dead-center, which causes the air fuel mixture to start burning to start the power stroke. The diesel cycle does not require an electric spark to start the combustion in the cylinder, but operates on the compression ignition principle, a metered volume of fuel injected at the proper time into the cylinder containing the highly compressed, high temperature air. As the average diesel fuel starts to burn at temperatures around 450° F., we can see that combustion is assured when it is injected into 1000° F. air.

The pressures on the diesel piston are naturally higher because of the high compression pressure. Actually it is true for any internal combustion engine, that the higher the compression ratio, the higher the combustion pressure, and the greater the efficiency. Proof of this can be found by reviewing the increase in compression ratio in our automobile engines throughout the years. Each increase has resulted in greater power and more efficient engines. In the diesel engine the compression ratio is far greater than that used for the gasoline engine, thus greater power with less fuel consumption is acquired. The pressure on the diesel piston, after the fuel is injected and combustion takes place, approaches 800 to 900 psi. At the completion of the power stroke, as the exhaust valves open, we find in the gasoline engine exhaust gas temperatures of 1800° F. or higher, and a carbon monoxide content of 2 per cent or higher. The exhaust gases leaving the diesel cylinder are much cooler, generally, between 700° F. and 1000° F. for naturally aspirated engines, and slightly hotter in turbocharged engines. The carbon monoxide content in the diesel exhaust is only a fraction of 1 per cent.

Possibly the greatest attribute of the diesel engine is its high thermal efficiency, and by reviewing the efficiencies of other sources of power, we can see why the interest in diesel engines is increasing. We know that a pound of typical petroleum fuel contains about 18,500 Btu's, or heat units, and when we consider percentages of these Btu's which are converted to useful work and the amount lost through waste heat, friction, exhaust, and cooling for the different engines, we can easily evaluate the efficiency of the diesel.

The steam engine, popular for many years with railroads, had a thermal efficiency of 6 to 8 per cent; the steam generators or turbines used in electric power plants operate with a thermal efficiency of 16 to 30 per cent; the gasoline engine, as found in the average automobile, piston engine aircraft, and other means of transportation, has an efficiency of 22 to 28 per cent; the diesel engine, used for railroad, marine, stationary power, truck and bus applications operates with an efficiency of 32 to 38 per cent. A simple evaluation of thermal efficiency might be to compare the above efficiencies with the amount of work received from a dollar purchase of fuel. These thermal efficiency figures are very important when considering engine operation over many thousands of hours of operation, even when we compare diesel efficiency with the higher efficiency of the modern automobile or truck engine, the increase can be significant. For example, a 200 horsepower gasoline powered truck may show a fuel mileage

of 5½ miles per gallon; a diesel equipped truck of equal power, operating under similar conditions, could show 6½ to 7 mpg.

While the full power efficiency of the diesel is of major importance, the operating efficiency at part throttle is also worthy of consideration, as engines are not always run to develop full power and speed. With the gasoline engine we are always concerned with a more or less fixed air-fuel ratio, regardless of the load applied. But the air-fuel ratio of a diesel engine is proportionate to the actual power output. This is understandable when we realize that at any given rpm, the diesel air intake will remain constant while the fuel injection rate is varied to handle the power demands on the engine. In the gasoline cycle the engine runs rich when the air-fuel ratio falls much below 10:1, and lean when it is above 15:1; the diesel engine air-fuel ratio starts too rich for clean exhaust operation at about 18:1 and can conceivably be leaned to 100:1 at light or no load.

For all general purposes, we can say that maintaining an air-fuel ratio in the diesel is unimportant and, in fact, there is always more than enough air compressed in the cylinder to burn the quantity of fuel injected. Furthermore, when we consider that regardless of the applied load, the gasoline engine will always operate on the theoretical 15:1 air-fuel ratio, even though the engine may be running only at part load, the combustion temperature is close to full load operation. One part of fuel always has to heat fifteen parts of air during combustion. Because of the variation in fuel injection rate, with constant air volume, the temperatures in the diesel are not as high. Because of these lower operating temperatures, less heat is lost to waste in the diesel.

Improvements in design, better metallurgy, increased operating economy, and higher thermal efficiency are the contributing factors to diesel's growing popularity. Progress made during the last few years surpasses by far the past history of diesel progress. Today, the diesel is on the threshold of many new applications—truly we can say that the diesel engine has come of age and will continue to become more popular each year.

Cummins Promotions

R. A. Cumming

Robert A. Cumming has been named director-engine sales, construction and industrial equipment for Cummins Engine Co. He joined Cummins in early 1960 as manager—Los Angeles regional office. Before joining the firm he was manager of manufacturing sales for Caterpillar. Other new promotions include: H. J. Graninger to director-engine sales, highway equipment; J. P. Morgan, to director-field sales; L. M. Griffin, to director-government sales; J. L. Keyes, to director-sales services; and W. D. Blizzard, to general manager, Cummins Diesel Sales Corp. Announcement was made by R. W. Franck, vice-president-sales.

READY NOW! The completely new 1960 edition of the **DIESEL AND GAS ENGINE CATALOG,** Volume 25, can now be purchased. If you design, purchase, sell, operate or service diesel, dual fuel, or gas engines, the Catalog is essential to you and your business. This giant, 442 page, 10½ x 13½", fully illustrated reference book has been rewritten, revised and brought up to date completely from cover to cover and costs just $10 postpaid anywhere in the world. Send checks, money orders or company orders to **DIESEL AND GAS ENGINE CATALOG,** 9110 Sunset Blvd., Los Angeles 46, Calif.

Marine Tractors Bulletin

A new 2-page condensed catalog gives features, specifications and shows installations of Harbormaster Marine tractors. Harbormasters are heavy-duty marine outboard and propulsion units, all in one complete package. A comprehensive table gives specifications on 17 models from 40 to 500 hp. For a copy of the catalog write Murray & Tregurtha, Inc., 80 Hancock St., Quincy 71, Mass. (ITS NEW)

OGP Division Conference

The Oil and Gas Power Division of The American Society of Mechanical Engineers will hold their 33rd Annual Conference and Exhibit at the Jung Hotel, New Orleans, La., from April 10-13, 1961.

Florida Diesel News

By **Ed Dennis**

SIMPLEX Sales Co., in Hialeah, will supply the two Waukesha marine diesel engines for repowering the 100 ft. Coast Guard patrol vessel *USS Brier.* The Waukesha diesels are rated 315 hp at 1200 rpm and have 2.5:1 Snow Nabstedt r&r gears.

MARY Clair, a 48 ft. Chris Craft cruiser from Bahia-Mar, Fort Lauderdale, was repowered by Ellis Diesel Sales & Service with a pair of General Motors 6V-53 diesels, 181 shp at 2800 each, with 2:1 r&r gears and Columbia 22x23 propellers. Also included was a 3 kw Onan diesel generating set.

TEN Caterpillar DW-21 motor scrapers (25 cu. yd.) with the help of several D9 Cat bulldozers to push load, were used to move nearly two million cu. yds. of dirt by the White Construction Co. in their road building job of Interstate #4 on the shores of Lake Monroe. The DW-21 tractors were powered by six cylinder 300 hp turbocharged Cat diesels.

THREE Clark five cylinder model HRA5TM gas engines with Amot engine safety controls and McCord lubricators were shipped via Inagua Arrow to Coatza-coal-cos, Mexico to be used in the oil fields.

A model HD21 Allis Chalmers dozer is used by the Standard Sand & Silica Co., of Davenport, to strip overburden from sand deposits. It is powered by a model 21000 Allis Chalmers turbocharged six cylinder diesel rated 225 hp at 1825 rpm.

SAW the two new 65TD Euclid backdump trucks (54000 lbs.) delivered to the Williston Shell Products at High Springs. These are powered with GM 6-71 diesel engines and have Bendix-Westinghouse air compressors.

FOR temporary electrical power, Minute Maid, at the grove under construction near Fort Pierce, is using a GM 4-71 diesel to power the Westinghouse 25 kva 120 volt 208 amp ac generator plus a 4 cylinder International Harvester 18 kva generating unit.

CUMMINS Diesel Sales Corp. at Tampa, repowered a Diamond T 723 hiway tractor for Deseret Farms of Melbourne with a Cummins C180 diesel (180 hp).

NORTH of Brooksville, the Lancing Rock Co. is currently using two Michigan front end loaders for loading finished rock into trucks. The model 175 has a JT, 162 hp Cummins diesel and the 275 A has an NTO-6-BI Cummins

turbocharged 262 hp diesel; both have Clark torque converters, transmissions and axles.

OVER in Nassau, Symonette took delivery of a model H50 Payloader tractor shovel with an International Harvester UD-282 diesel rated 90 hp at 2200 rpm from Florida Georgia Tractor Co., Miami.

AT Port Everglades, the Port Everglades Towing Co. is operating the 81 ft. sister towboats *Fort Lauderdale* and *Hollywood*. Each is powered by a model DMQ36 Enterprise diesel engine. These 16x20 diesels are rated 1200 hp at 300 rpm.

JACKSONVILLE Branch, Detroit Diesel Div. supplied the diesel for the twin screw, 50 ft., Huckins cruiser, *Vorlage*, owned by E. G. Swaggert, along with the 6-71 series diesel engines were 1:1 hydraulic r&r gears and 1.38:1 Huckins V drive.

GOLD plated valve covers will be on the two Onan 3MDSL three kw 25 amp 60 cycle generator sets when Capt. Al Starts launches his 80 foot *Southern Belle*, a paddle wheel showboat to operate around Fort Lauderdale.

ON the Miami docks, headed for West Indies Ports, a Caterpillar 944 A traxcavator plus a 955 series H crawler traxcavator along with a model D342O Caterpillar 150 kw, 187 kva, 1200 rpm generating set with a Maxim Silencer.

CITY of St. Cloud received a model 841 Fordson loader and backhoe tractor, powered by a Ford diesel engine developing 37 hp at 2000 rpm.

THE W. & M. Construction Co. of Williston received a Seaman-Andwall Pulvimixer powered by a General Motors 6-71 diesel engine and a Fuller 4-A 86 transmission for highway construction work.

A Mercedes-Benz diesel, model OM636 rated 36 hp at 3000 rpm, powers the 12½ kw Onan generator recently installed on the houseboat *Jimp* of Fort Lauderdale.

MODEL GD157, Continental four cylinder diesel engines, 39 hp at 2000 rpm, supply power for the three Lincoln shield arc welding machines on the dredge *Barlow* currently dredging Miami harbor.

A GM 4-53 diesel, 130 hp at 2800 rpm, was used in repowering from gasoline in a White highway tractor for Nationwide Moving Co. of Tampa and a GM 4-71 E diesel was used in a similar repowering job for the Greenville Lumber Co. of Greenville. Both installations used the original transmissions.

AT Kissimmee we saw their new dual fuel Fairbanks Morse model 31-AD-18 diesel in operation. It is rated 4200 hp at 277 rpm and drives a 3000 kw Fairbanks Morse generator. Also included in the installation are Hilco lube oil filters and a Woodward UG32 governor.

Truck Fleet Featured

Featured in the Fuller Manufacturing Company's magazine, *Transmission Topics*, is the fleet of the Schwerman Trucking Co. of Milwaukee, Wis. A carrier of bulk cement and petroleum, operating in 11 states. The first installment of a two-part instructional story, "The Proper Installation and Maintenance of Trailer Axle Assemblies," also appears, along with other articles outlining transmission installations. From material supplied by the Shuler Axle Co., the second half of the axle story will appear in the next issue of *Transmission Topics*. A copy of *Transmission Topics* may be obtained from Fuller Manufacturing Co., Transmission Division, Kalamazoo, Mich.

Mid-West Diesel News

By **L. H. Houck**

TWO Allis-Chalmers model 21000, 200 kw generator sets to D. Leone Construction Co., Trinidad, Colo., from Power Equipment Co., Denver. Units were used to power a Barber-Greene, model 848-A hot-mix plant.

LYLE Seymore, Bird City, Kan., has installed an Allis-Chalmers model 16000 diesel irrigation engine on a deep well turbine pump. Unit was furnished by Power Equipment Co.

INLAND GM Diesel, Inc., Milwaukee has delivered six of the new 6V-53's, the new GM diesel, to Speedway Transports, Inc., Kenosha, Wis., for installation in Ford F-800 trucks.

RENT-A-Truck, Inc., Brillion, Wis., is converting five IHC CO-205 units to GM-4-71E diesels from Inland GM Diesel, Inc., through Baur Truck Sales, Appleton, Wis.

TIP Top Creamery, a division of Beatrice Foods, Inc., has taken delivery of a 1961 NCT-900 Dodge diesel. The unit is a member of the creamery's 159-unit fleet. This is a pilot job hauling a 42,000 lb. payload which may lead to complete dieselization of the fleet.

KANSAS CITY Transit, Inc., has added 22 new air-conditioned "Silver-Liner" buses with GM diesels to its large fleet.

MURPHY diesel dealer, Cummings, McGowan and West, St. Louis, is building a new $100,000 facility south of 8600 Olive St.

THREE model 840 John Deere diesels with Hancock scrapers to Steelman Const. Co., Oklahoma City, from Oklahoma City Equipment Co.

H. D. Youngman Const. Co., Oklahoma City, has taken delivery of a model 604 Lima crane with Caterpillar 326 diesel, 1½ yd. bucket, from R. A. Young & Son, Inc., Okalaoma City.

R. A. YOUNG & Son, Oklahoma City, has delivered a model 34 Lima dragline with ¾ yd. bucket and 4-71 GM diesel, to Sooner Const. Co.

RUFUS Bryant, Oklahoma City, has taken delivery of a model 440 John Deere crawler from Oklahoma City Equipment Co. This has a 2-53 GM diesel.

BUCKEYE Ditcher, model 308, with a 3-71 GM diesel to Geo. W. Davis Construction Co., Oklahoma City, from Oklahoma City Equipment Co.

INSLEY 45 ton truck crane, mounted on a Crane Carrier built truck with Cummins diesel, to Moore Bridge Co.

ALLIS-Chalmers model 21000 diesel power unit for operating complete sawmill of Fleming Lbr. & Mercantile Co., Minturn, Colo. Unit has a 50 kw generator driven from front crankshaft pulley and a Lufkin 200 hp gearbox direct drive to flywheel which provides the various types of power needed. Sale made by Power Equipment Co.

U. S. Motors Corp., Oshkosh, Wis., is using GM diesels, models 6V and 8V-71 in their uninterrupted emergency generator sets. Units supplied by Inland Diesel, Inc., Milwaukee.

MARQUETTE County Highway Department, GM model 4058C (4-71) for repowering a heavy duty truck. Sale by Inland GM Diesel, Inc., and assistance on installation details.

COLORADO Springs, Public Utilities

Department, has bought an Allis-Chalmers diesel from Power Equipment Co. for repowering a motor crane.

PETER Kiewitt & Sons, Oklahoma City, two model 820 John Deere tractors with JD diesels from Oklahoma City Equipment Co.

VAUGHN & Taylor Const. Co., Odessa, Texas, an 820, 2-cylinder diesel, John Deere tractor and Hancock scraper from Oklahoma City Equipment Co.

UNITED Air Lines, Denver, two Allis-Chalmers model 21000 200 kw diesel generator sets for standby service at United's new reservation central inventory facilities at Denver.

Tachometer Bulletin

A bulletin covering their line of electric tachometers, including types for stationary, marine and vehicular diesel applications has been published by The Electro-Mechano Co. The four page illustrated bulletin outlines the various types of electric tachometers available, gives dimensional drawings and also shows the firm's line of ac and dc type tachometer generators. For a copy of the bulletin write The Electro-Mechano Co., 241 E. Erie St., Milwaukee, Wis.

ITS NEW

New Gas Turbine

Waukesha Motor Co. has developed a new industrial type gas turbine. This unit develops 400 horsepower for use in industrial, military, marine, automotive, oil field, and similar applications. The design, assembly, and testing of the turbine was done in collaboration with the Williams Research Corporation in that company's laboratories near Pontiac, Mich. The turbine incorporates a centrifugal compressor, annular combustor, two-stage turbine section, and integral speed reducing gear case. The unit is a free shaft engine, providing high torque characteristics for truck and off-the-road vehicle applications and can be converted to a fixed shaft version for alternator drive and other constant speed applications. The 400 hp rating can be provided at output shaft speeds of 2500 rpm or 3600 rpm with the free shaft feature providing very high torque at zero rpm. It is anticipated that this same engine will be rated in the future at 600 hp for some applications. The conservative design provides for a full power minimum period, between overhauls, of 20,000 hours. The use of sleeve bearings, throughout, (including high speed shafts bearings), is one of many innovations identifying this engine as a heavy duty unit. The turbine engine is a free shaft unit with provisions for conversion to fixed shaft for alternator drive applications. Compressor speed is 36,800 rpm and power turbine speed is 25,270 rpm. The engine length (intake to end of output shaft) is 50 in., width over the exhaust collector is 28 in. Output shaft speed of 3600 rpm is reducible to 2500 rpm within the same gear case by changing gears. Engine weight of 620 lbs. includes fuel pump and control, less starter-generator. Ratings are with 100° F. inlet air; hence, substantially higher ratings are available with normal inlet conditions.

Filter Wrench

A new universal tool for the installation and removal of spin-on oil filters for automobile, truck and tractor use is in production by The Milbar Corp. The two-way cam action of the oil filter tool, Filtrench eliminates the necessity for strap and chain arrangements currently used. Designed to handle either smooth or rotunda type filters of varying sizes or with built-in hex nuts, this dual-action tool can be used without "close quarter" problems. For further information write Milbar Corp., 1900 Euclid Ave., Cleveland 15, Ohio.

ITS NEW

Fishing Cruiser *Swiftwind*

The *Swiftwind* was the first all aluminum welded vessel to be built by Diesel Shipbuilding Co. of Jacksonville, Florida. This de luxe fishing cruiser, constructed of ¼ in. aluminum plate for the hull and $\frac{3}{16}$ in. aluminum for the deck house, has five water tight bulk heads, all of aluminum. The 55 ft. craft is big enough to be comfortable and light enough to be swift and economical to operate. It has a beam of 14 ft. and a draft of 3 ft. 9 in. The *Swiftwind* has, for propulsion, a pair of General Motors 6-71 turbocharged marine diesels each rated 300 hp at 2300 rpm. They turn the five bladed Federal propellers through 2:1 Allison hydraulic reduction gears and two inch diameter monel shafts for a top cruising speed of 26 mph. All piping and tubing is of aluminum. It has a fuel capacity of 1900 gal., enough for approximately 1500 mi. of cruising, and a 900 gal. fresh water capacity.

Thermostatic Heater

Phillips Manufacturing Co. announced addition of a new thermostatically controlled external tank-type heater to its line. The thermostatic feature of the new model serves as an automatic shutoff should the engine reach preset temperature or should the unit have been improperly installed so as to restrict coolant circulation. The coolant is warmed and circulated throughout the entire engine by thermosiphon action. This action, the manufacturer states, warms all moving parts of the engine and assures fast starting. Zero Start thermostatic heaters are available in six models. For complete information write Phillips Manufacturing Company, 8200 Grand Avenue South, Minneapolis 20, Minnesota. (ITS NEW)

Division Sales Manager

B. M. Joseph

Burton M. Joseph has been appointed sales manager of the Industrial and Oil Field Division of the Young Radiator Co. Mr. Joseph has been employed by Griscom-Russell Co., Massillon, Ohio, manufacturers of heat transfer equipment as a sales engineer, and by Yuba Industries, Inc., San Francisco, Calif., also producers of heat transfer equipment as district sales manager. Immediately prior to his appointment at the Young Radiator Company, Mr. Joseph, was general sales manager of Solar Chicago, a division of U. S. Industries, custom plate fabricators and producers of process equipment.

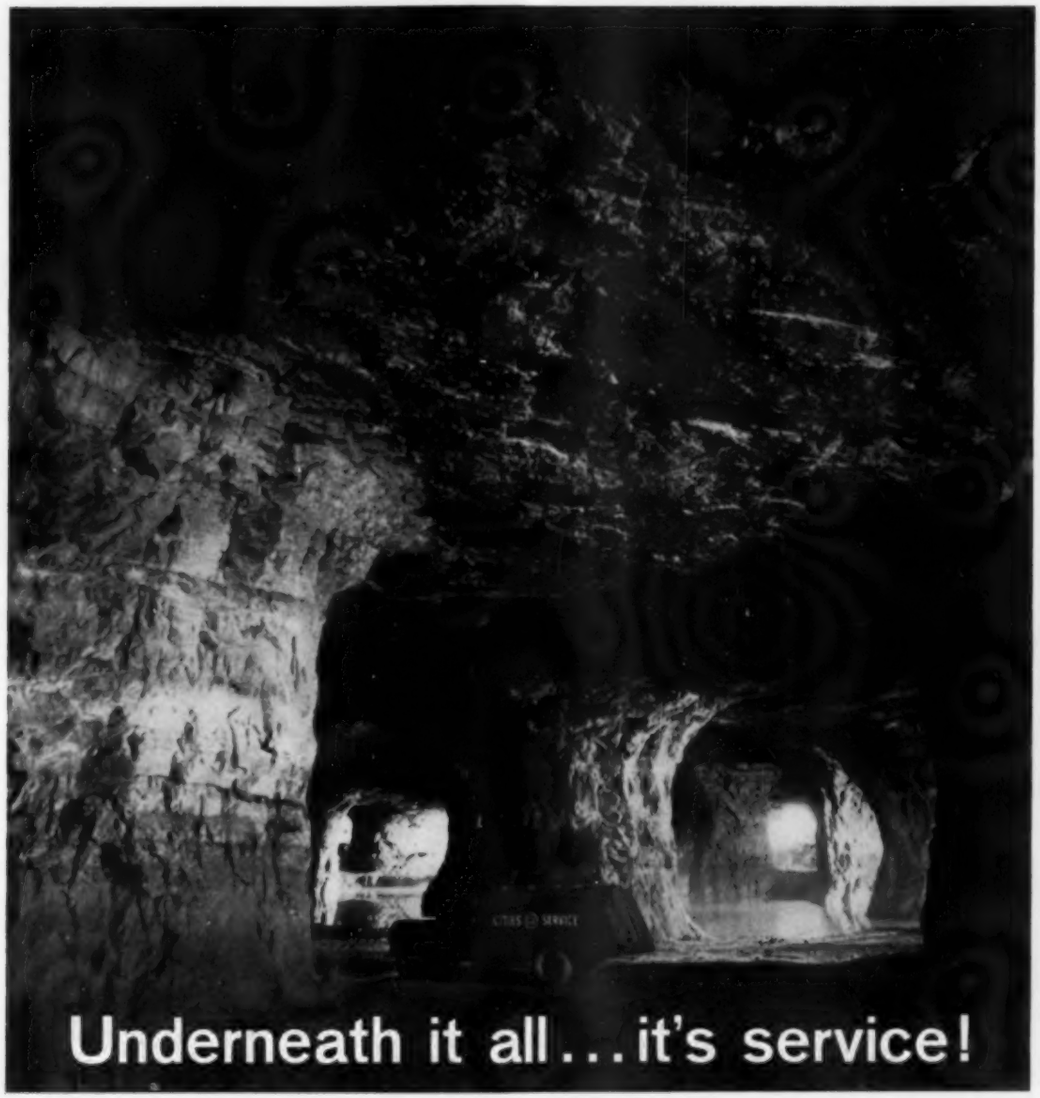
C-B Sales Appointments

The Cooper-Bessemer Corp., has announced appointment of David Salls as manager of gas industry sales and William B. Boyum as manager of gas turbine sales. Mr. Boyum has had a distinguished career in the field of gas turbine design and engineering, with 10 years direct experience in this field. During this period he was responsible for design engineering and special projects in the gas turbine department of Westinghouse Electric Cor-

David Salls

W. B. Boyum

poration. Mr. Boyum was responsible for new products and new markets for the Cryogenic Machinery Division of Air Products, Inc., and Dynamic Research, Inc. before his Cooper-Bessemer appointment. Prior to his new appointment, Mr. Salls was manager of the company's Gas Turbine Sales.



Underneath it all... it's service!

THERE's only one way to get to the Weiler Marble Company quarry of Ste. Genevieve, Missouri. Down a rough dirt road . . . over a steep hill . . . and deep into the ground. This is no problem to Cities Service. It's just another example of how every customer gets reliable service . . . no matter where he is!

The Weiler Company has depended upon Cities Service for the past 2½ years. Mr. Herman Weiler, President, is impressed with the products as well as the service. For drilling, his company counts on Neptune 13Z oil. He states, "It's the best drill oil I've ever used. Really sticks to the metal it's applied to."

Mr. Weiler's Schramm 600 air compressor engine has been running 12,000 hours on DC-300 oil without a repair. Results such as this convinced him to use nothing but Cities Service products for all his equipment.

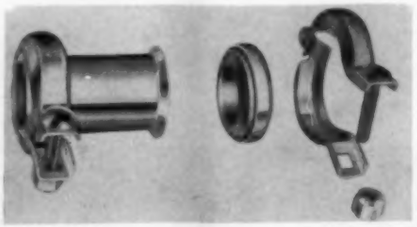
Mr. Weiler gets expert technical help, fast dependable service, and the best products available . . . all from Cities Service. You will, too! For more information, contact your nearest Cities Service Office or write: Cities Service Oil Company, Sixty Wall Tower, New York 5, New York.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

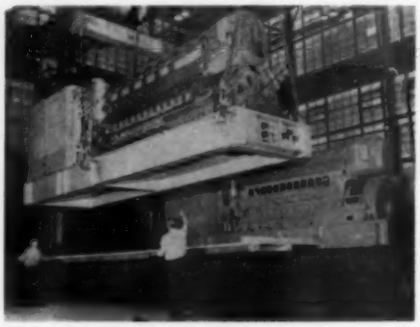
Improved Pipe Coupling

Marman's Flexmaster pipe coupling is now available in an improved design and in a wider range of standard pipe sizes from ⅜ to 4 in. and in lengths from 2 through 36 in. A new gasket is now fully contained in the gasket retainer to assure uniform pressure of the gasket against the pipe and sleeve. Redesign of the coupling ends has increased the band tension load to provide a stronger joint. New elbows, crosses and tees are now also available. Joints can be supplied in either cadmium plated steel or with a black painted finish. The Flexmaster absorbs pipe vibration and shock and is corrosion resistant. It allows up to 4° angular misalignment and permits both angular and axial pipe movement without leakage. Further information about these joints may be obtained by writing for Flexmaster Bulletin No. 805 from the Advertising Department, Aeroquip Corporation, Marman Division, 11214 Exposition Boulevard, Los Angeles 64, Calif. (ITS NEW)



Generator Set Heads For Venezuela

After it was lowered onto a flat car at the Beloit (Wis.) Works, a 48-ton self-contained, packaged generating set (see cut) joined three other identical Fairbanks-Morse units on the rail-and-sea journey to a Phillips Petroleum Co. power plant being built in the Southern Monagas, Venezuela oil fields. The engine can operate on any of three fuels, and the radiator and fan are in a completely self-contained unit (extreme left) so that they can be situated outside of a building with the engine and generator on the inside. Fairbanks, Morse equipped and shipped the 12-cylinder, 1920 hp engine as a spark-ignited natural gas engine. However, it was shipped with additional parts, for



mounting in the field, so that the engine can be operated also as either a straight oil diesel engine or as a dual-fuel engine using proportionate amounts of natural gas and oil. Phillips will use the four engines to supply prime power for producing, gathering and pipe line transmission of crude oil from the Venezuelan wells. Each unit consists of a model 38D8 ⅛ engine, running at 720 rpm, direct driving a 1360 kw 3-phase 60-cycle, 4160-volt generator with its own belt-driven top-mounted exciter.

Worthington Research Head

Worthington Corporation's Compressor and Engine Division, Buffalo, has announced appointment of Malcolm L. Land as director of research for the Division. Mr. Land will be concerned with research and development projects on reciprocating compressors, gas and diesel engines.

M. L. Land

Prior to joining Worthington, Mr. Land occupied management positions with Air Products, Inc., a manufacturer of process equipment, and was formerly chief engineer, Supercharger Division, Elliott Company.

BENDIX BROADENS ITS DIESEL FUEL INJECTION CAPABILITIES WITH ADDITION OF SIMMS LINE

Through a recent agreement with Simms Motor Units, Ltd. of London, England, Bendix will market and manufacture Simms fuel injection equipment for diesel engines in the United States. Thus, diesel engine manufacturers and users will benefit through an extremely wide range of equipment for their fuel injection needs.

Equipment manufactured by Scintilla Division of Bendix today is serving the fuel injection needs of leading U. S. diesel builders, particularly in the high-horsepower class. Now, with the addition of the Simms equipment, Bendix can offer multi-cylinder pump units adaptable to small- and medium-sized engines. Simms equips many makes of British diesels, as well as Ford diesel-powered farm tractors built in this country.

The nation-wide organization of Bendix® fuel injection equipment distributors and service dealers will perform equivalent functions on the Simms units, with prompt deliveries and efficient service. For details, write:

Scintilla Division
Sidney, New York

THE Bendix CORPORATION

Export Sales & Service: Bendix International Division, 205 East 42nd St., New York 17, N. Y.

Navy Minesweeper

Peterson Builders, Inc., Sturgeon Bay, Wis., delivered their tenth non-magnetic minesweeper for the U. S. Navy to the Boston Naval Shipyard in a one week trip via the St. Lawrence Seaway. The vessel is 172 ft. 11¾ in. overall, has a beam of 35 ft. 1¼ in. and draft of 10 ft. 4 in. Displacement is 750 tons. The ship is powered by two GM Cleveland model 8-278A (NM) diesel engines rated 800 bhp each at 750 rpm. The engines each turn a 7 ft. dia. controllable pitch, three-blade Bird-Johnson propeller through 6½ in. aluminum bronze shafts. Auxiliary and ships power is supplied by GM Detroit model 6902 (NM) 100 kw generating sets. Diesel oil capacity is 44 tons, lube

oil capacity is 2 tons. The delivery crew consisted of Peterson employees. Navy complement on the sweeper is five officers, six petty officers and 63 crewmen.

American Bosch Promotes Two

Appointment of A. John St. George as manager of planning and administration and Robert P. Ensign as Ensign product manager has been announced by American Bosch Arma Corp. Both Mr. St. George and Mr. Ensign have been associated with American Bosch since that company acquired Ensign Carburetor Co. of Fullerton, Calif., and the two were subsequently merged. Mr. St. George had been Ensign product manager for the American Bosch Arma Commercial Sales Division. He will supervise the service, market research, advertising and operating services departments of the Commercial Sales Division; also sales liaison with the American Bosch Arma plant at

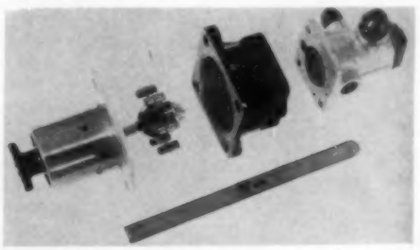
A. J. St. George

R. P. Ensign

Columbus, Miss. Mr. Ensign had various executive positions with the Ensign Carburetor and since the merger has been assistant to the works manager and has had charge of Ensign manufacturing operations. He now has charge of all marketing activities on Ensign products.

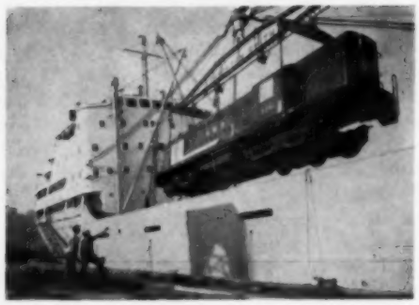
Pneumatic Governor

Design simplicity is the feature of a new pneumatic governor developed by The Garrett Corporation's AiResearch Manufacturing Division, Phoenix, Arizona. Pointing to this feature is the elimination of seals, bearings and flyweights which according to Garrett engineers results in long accurate life with very low hysteresis. In one application the unit serves as an engine-driven speed sensitive valve installed on a turbine engine to provide pneumatic signals to a compressor bleed valve at predetermined rotor speeds. An ultimate 10,000 hour overhaul life for the AiResearch unit is predicted. AiResearch pneumatic governor dis-



assembled to show, from left, drive gear assembly, with special flexure-spring rotating assembly attached; housing for rotating assembly, and switcher valve. In operation when rotor speed increases, the centrifugal force overcomes the pre-load of the flexure-spring causing an internal push-rod to move along the axis of rotation and thereby adjust the pressure controlling the position of a piston operated poppet valve in the upper housing. The high energy engine bleed air flow controlled by the poppet is then utilized to operate a suitable control actuator. (ITS NEW)

Ship Locomotives to India



Norwegian ship *Belkarin* sailed from New York with a shipment of new diesel-electric locomotives manufactured by Alco Products, Inc. of Schenectady, N. Y., for the North Western Railways of Pakistan. The locomotives were designed for both passenger and freight service in Pakistan. They are Alco's six-motor, 1800 hp class DL-541 units, each of which is powered by a 12-cylinder, Alco model 251 diesel engine. The ship's destination was Karachi, Pakistan.

National Forge Announces Production of D-H Vacuum Steel

The National Forge Co. of Irvine, Pa. has begun production of its D-H vacuum steel, having successfully treated three heats on the first day of operation. This advanced vacuum process is designed to remove gases from the steel, while simultaneously providing a means of alloying under vacuum. Early heats show a marked reduction of hydrogen and oxygen, and accurate chemical analysis. The pick-up of nitrogen between melting and teeming has been avoided. The vacuum unit was designed and built by the Lectromelt division of McGraw-Edison Co., based on recent development work at Dortmund-Horder Huttenunion, one of Germany's largest steel producers. According to Duane E. Wilder, executive vice-president of National Forge, with the D-H system alloying and deoxidizing additions are made under vacuum. This procedure is possible because the vacuum treatment takes place in an easily heated vessel, preventing significant heat loss, and the treatment itself provides thorough mixing of the steel. Both killed and non-killed steels can be treated, with deoxidizing agents being added, if necessary, in the vacuum vessel just prior to teeming. Precise amounts of alloying elements are also added, with very little loss, during the vacuum treatment. Mr. Wilder also stressed the flexibility of the system. Heats from ten to sixty tons can be treated as often as eight times in a 24-hour day, giving National Forge the facility to treat all the steel they melt. National Forge expects that their D-H vacuum steel will, due to its reduction of gas content, provide forgings free from hydrogen flaking, allowing reduction of heat treatment required in many grades of steel. The reduction of oxide inclusions should also result in improved mechanical properties. National Forge specializes in the production of carbon, alloy, and stainless steel forgings made from electric furnace steel. They melt, heat treat, and machine a wide variety of forged products, including diesel and gas engine crankshafts.

A completed heat of D-H vacuum steel is about to be released from the new vacuum treating unit installed at National Forge Co. Control room is at upper right.

GM Dynamometer Calculator

A new concept in the presentation of data needed to determine whether or not GM diesel engines on dynamometer test meet all factory-approved operating standards is incorporated in a new device now available to service outlets of GM Diesel engine distributors and dealers. According to C. B. Clum, general service manager of the Detroit Diesel Engine Division, this information has generally been available only through reference to various factory publications. The new device, designated as a dynamometer calculator, at the turn of a dial, reveals all test information required for any engine in the GM Diesel line. The information is provided by means of a rotating wheel within the calculator. The wheel contains over 8,000 variables, which are coordinated with 54 basic model designations. As a model is dialed, accurate information pertaining to bhp, torque, lubrication pressures and all other data at the various throttle settings required appears in windows cut in the front of the calculator. With this information readily available for comparison with actual dynamometer readings the operator can determine at once whether or not the overhauled engine meets all factory operating standards.

New Engine Catalog

Features of the recently introduced Allis-Chalmers model 10000 and 11000 diesel engines are described in a new, illustrated two-color, eight-page catalog (BU-718) now available from the Allis-Chalmers Mfg. Co., Engine-Material Handling Division, Milwaukee, Wis. Performance curves and charts, and illustrations, including cutaways of important components, are included to explain "A New Kind of Diesel Work Power" provided by these two new engines in the 100-210 hp class. (ITS NEW)

Cuno Sales Engineer

Donald S. Onnen has been named a member of the sales engineering division of The Cuno Engineering Corp. Onnen joins Cuno after five years as chief equipment engineer and operational director of research for the New York, New Haven, and Hartford Railroad. Earlier he was associated with the General Electric Co. in various technical, engineering, and sales capacities for fourteen years, including foreign service in South Africa and Europe.

ADS Sets Repair Standards

Establishment of standard work titles and classifications for the repair and overhaul of diesel fuel injection equipment has been announced by Henry B. Sirotek, president of the Association of Diesel Specialists. Mr. Sirotek stated these standards are the result of more than a year of research conducted by the Standards Committee of the Association under the chairmanship of Lloyd Bailey, president of Diesel Injection Service, Louisville, Ky. The following classifications for the repair standards have been established: 1. Complete overhaul, 2. Necessary minor repairs, and, 3. Testing only. A complete explanation of the work involved in each classification is clearly outlined so that both customer and repair shop know exactly what type and how extensive service is expected. Service members of the Association have been furnished 14 in. x 18 in. two-color posters to be displayed in their shops so customers can be familiarized with the repair standards. Mr. Bailey, chairman of the Standards Committee of ADS stated that "these standards will help materially to clarify the repair service to the customers, the service shop and the manufacturer." A reproduction of the A.D.S. repair standards poster may be obtained free by writing to the Association of Diesel Specialists, 633 East 63rd Street, Kansas City 10, Mo.

Engine Sales Manager

Appointment of Ed Cryer as engine sales manager of Peterson Tractor Co. has been announced by Howard Peterson, president of the Caterpillar dealership at San Leandro, Calif. Mr. Cryer has been with Peterson's ten years and formerly was a service representative with Caterpillar Tractor Co. Most recently, he has been in charge of sales for Peterson Marine, a division of Peterson Tractor Co.

Field Personnel Shifts

Stewart & Stevenson Services, Inc., Houston, has announced a shift in field personnel assignments in North and West Texas locations. Dick Brough, former operations manager at the firm's Odessa branch has been transferred to Lubbock as manager of the firm's sales and service facilities at that location. Royce Garner succeeds him as Odessa Operations Manager. Prior to his new assignment Mr. Garner had served as assistant operations manager at Odessa.

Inland River Reports

By A. D. Burroughs

THE familiar *Wm. Penn*, often-spotted on the Ohio, is plying under the new name, *R. H. Bosworth II*. The 176x36 ft. towboat, powered with two National Superior engines for the rated 1400 hp, was purchased by the Point Towing Co., Point Pleasant from Union Barge Lines.

A versatile craft, designed for push or pull, has been delivered by Southern Shipbuilding Corp. to Esso Standard for duty in the New York Harbor. The 85x 26 ft. craft, christened *Esso Pelham*, has a rated 640 hp supplied by twin Fairbanks-Morse engines.

NEW *Diana Brent*, equipped with a GM engine for the rated 900 hp, has entered the petroleum trade. The 78x24 ft. towboat is the fifth to join the rapidly expanding fleet operated by the Brent Towing Co., Greenville.

TWO Caterpillar engines, model D342, supplied by Fabick Bros. Equipment Co., Sikeston, Mo., provide 440 hp for the new switchboat in service for owner Cape Girardeau Sand Co. Named the *Linder Diemund*, the 52x15 ft. craft was completed at the owner's plant.

NEARING completion at Siracusa Shipyard, Morgan City, was a new tug for Siracusa and Verret Towing Co. The 55x17 ft. vessel is scheduled to carry two GM 6-71 engines for the planned 450 hp.

UNITED Electric Coal Companies, Chicago, has placed their new towboat, *Ruth E.*, in action on the Illinois Waterway. Completed by Humboldt Boat Service, St. Louis, the 50x18 ft. craft has push-power provided by twin Cummins model NH6M for a total 350 hp.

WE watched the sparkling-new towboat, the *Austen S. Cargill*, making good time with a good tow. Completed by St. Louis Shipbuilding and Steel Co., for Cargo Carriers, Inc., the towboat has ample power with a rated 6630 hp supplied from three Cooper-Bessemer engines.

THE big *Valley Voyager* was at work for Mississippi Valley Barge Lines, putting in efficient service with her Nordberg power. The 200x45ft. towboat is starting the fourth year of duty with a rated 6000-plus hp from two Nordberg Supairthermal V-12 engines.

UNION Barge Line's towboat, *Eastern*, applied its 3500 hp supplied from White Motor Co. Superior engines, to push the famous barge *Paleamon*. The barge is specifically designed to carry the booster components for the Saturn space rocket.

THE *Betty Moran* was another exceptionally active boat in recent weeks. The 1956 production from St. Louis Shipbuilding and Steel Corp. was the first new inland towboat to perform for the Moran firm. Two GM engines supply the rated 2160 hp.

BOB Benter, 140x35 ft. towboat operated by The Ohio River Co., powered by Baldwin-Lima-Hamilton engines for the rated 2160 hp, received news space as the boat used by government and civic officials during an Ohio River tour.

SOME of the newer vessels were sighted including the new *Jayne Hougland*, built by Nashville Bridge Co. last year for Hougland Barge Line. The 150 ft. towboat receives power from GM model 16-567C engines for her rated 3200 hp.

THE *Bill Wolter* was busy for Cairo Terminal and Fleeting Co., with 600 hp delivered from a pair of Caterpillar engines. The 55x22 ft. towboat is the second craft to carry this name.

Twin Turbine Boat

A propulsion system using twin Solar Saturn gas turbine engines has been ordered by the U. S. Coast Guard for installation in a new 82 ft. patrol boat, Morris Sievert, Solar's turbomachinery sales manager, has announced. The two Saturn engines will give the boat a 2200 hp propulsion system for high speed search and rescue operations. The variable speed engines will drive controllable pitch propellers. Throttle and propeller control will be synchronized into one control unit. Delivery of the propulsion system to the Coast Guard is scheduled for February. The 82-foot patrol boat—designated WPB, is being built at the Coast Guard yard, Curtis Bay, Md.

Spray Products Brochure

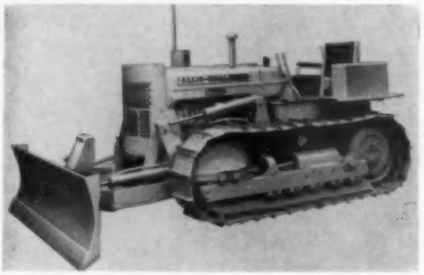
Spray Products Corp., has produced a brochure on its product line for marine, logging, automotive, farm and industrial applications. Featured are descriptions and illustrations of the company's starting fluids, fire extinguishers, spray gear lubes, diesel fuel additive etc. A copy of the brochure can be obtained by writing Spray Products Corp., P.O. Box 1988, Camden 1, N. J. (ITS NEW)

Delco Products Promotions

New appointments and reassignments in the Industrial Motor and Generator sales department have been announced by William J. Wagner, general sales manager of Delco Products Division of General Motors. Allan C. Wight has been appointed sales manager for generators, defense sales and railroad equipment. Carl L. Holverstott will be sales manager of industrial motors. Mr. Wight has been with Delco Products since 1947 and has progressed through assignments as service engineer, sales engineer, new products manager and sales manager of Delco-Matic garage door operators. Mr. Holverstott joined Delco Products in 1939 and has served as test engineer, sales and service engineer, supervisor of appliance motor sales, and sales zone manager.

New Crawler Tractor

Allis-Chalmers has expanded its crawler tractor line to include a new compact unit—the HD-3 with a 40 hp diesel engine having four cylinders, and a $3\frac{3}{4}$ x $4\frac{3}{4}$ in. bore and stroke, and 15.35:1 compression ratio. It is rated at 1650 rpm. Ruggedness is designed into this new crawler tractor. The main frame is 6 x 4-in. angle steel $\frac{5}{8}$-in. thick. A large front beam and 3-in. diameter rear axle joins the frame and track assembly, which in turn is



anchored to the final drives. Fast, smooth direction reversing is accomplished with a shuttle clutch that eliminates foot clutching or gear shifting. The shuttle clutch lever has three positions—forward, neutral and rearward, and provides smooth, intermediate precision control between forward and rearward. The transmission has four gears providing speed ranges from 1.3 mph in first gear to 4.8 mph in fourth gear. Speeds are equal in both forward and reverse in any given gear. The big capacity hydraulic systems available for the crawlers add further to operational ease. (ITS NEW)

Repower Yacht

The 43 ft. Wheeler promenade deck yacht was recently repowered with a pair of Cummins C-175-M marine diesels to give added cruising range combined with economy and safety in operation. The boat is owned by John Poole of Detroit, Mich. Allied Marine Corporation of Miami, Florida installed the diesel engines which are rated 175 horsepower at 2500 rpm driving through Capitol model 2HE-HD-10200 marine gears having 2:1 reduction. Federal 26 x 22 in. three-blade Equipoise propellers drive the *Iroquois* to a maximum speed of 17.3 mph. The boat cruises at 14 mph. The owner reported a savings of 55 per cent in fuel costs using diesel over gasoline. A 13 per cent increase in the speed of the boat was noted with the change to diesels.

New Hose Clamp

A new clamp for hose or other general industrial applications is now being marketed by Marman Division of Aeroquip Corp. The Marman hose clamp has no perforations through the band to cause extrusion or scuffing of rubber. The steel screw engages on coined threads. Precision manufactured to prevent snapping open or jogging loose, the clamp can be removed easily if required. It also provides uniform clamping pressure and will not distort thin wall tubing. Wide diameter adjustment is possible because of a high strength band. Another feature is the unusual band take-up which is directed away from the fastening side of housing to eliminate interference during assembly. The deep slotted steel screw is encased in the housing to allow easy, positive screwdriver engagement. Further information about the new hose clamp may be obtained by writing the Advertising Department, Marman Division, Aeroquip Corp., 11214 Exposition Blvd., Los Angeles 64, Calif.

ITS NEW

Re-Babbitting Machine

Now installed and operating at A. Moe & Co., Inc., Philadelphia, is a Golten centrifugal re-babbitting machine for restoring large bearings. Mr. Joseph G. Cannon, President said, "This represents a substantial investment to enable A. Moe & Co. to diversify further into repairs of industrial bearings." The novel Golten machine shown above can handle bearings up to 26 in. inside diameter. It achieves even distribution of molten babbitt metal through spinning after the bearing is mounted on a rotating face plate. Members of the A. Moe staff have received special training at the Golten works in Brooklyn to become qualified operators.

200th Turbine Compressor Delivered

Boeing's Industrial Products Division has delivered over 200 gas turbine-driven compressors for airline ground support. The 200th unit was a truck-mounted Boeing Turbo-Starter shown being readied for delivery to Pan American World Airways. Pan American put the first Turbo-Starter into service two years ago. This 200th unit is also the first of a new model of the Boeing Turbo-Starter delivered to a commercial customer. The new turbine compressor model includes turbine wheels of fir-tree manufacture. The term "fir-tree" describes a turbine wheel with mechanically-attached blades. This feature substantially reduces maintenance costs as fir-tree assembly makes possible the replacement of damaged turbine blades. Wheels formerly were of welded construction and a damaged blade meant the scrapping of the entire wheel. Inspecting a fir-tree turbine wheel, which is one of the smallest produced today, are Steve Beggs, Boeing technical representative in charge of Turbo-Starter sales, left, and J. S. DeLisle, Pan American supply manager in Seattle.

West Coast News

By James Joseph

EGIL Kleven, Seattle, has repowered his 65 ft. dragger boat with a 21000 Allis-Chalmers marine diesel (230 hp at 1600 rpm), the engine equipped with Schwitzer turbocharger, and Capitol 3.88:1 hydraulic marine gear.

SOLD: to Orange Unified School District, Orange, Calif. four Crown coaches with Cummins NHH-220 horizontal engines (220 hp at 2100 rpm).

PETER Kiewit & Sons Co., Long Beach, Calif. contractors, has taken delivery of a Hough Payloader powered by a Cummins C-175 (175 hp at 2500 rpm), for waterfront project.

TO the Nevada Club, Reno, a Caterpillar D333 turbocharged diesel electric set (125 kw, 1800 rpm) as standby for the gambling casino. Sale by San Leandro, Calif.'s Peterson Tractor Co.

RIVERSIDE Cement Co., Riverside, Calif., a division of American Cement Corp., has purchased 18 new Kenworth tractors (with 220-hp Cummins diesels). Delivery via J. T. Jenkins Co., Los Angeles.

TWO new Diamond T motor truck franchises—handling company's heavy duty truck line, including diesels—have been awarded to Connell Motor Truck Co., Inc., Sacramento, Calif. and to Hudgins Diamond T Sales & Service, Denver.

TO Hooker Paving Co., Big Pine, Calif., a Michigan front-end loader powered by a Cummins C-160 (160 hp at 2500 rpm). Sale by Los Angeles' Cummins Service & Sales.

FOR Oregon's Nat MacDougal Construction Co., a new model 1250 Lima shovel powered by an Allis-Chalmers 21000 diesel (340 hp at 2100 rpm, with 16.1 Clark converter). Sale by Hamilton Engine Sales, Inc., Portland.

WAYNE Tingston, Hemet, Calif. has taken delivery of a Wagner tractor powered by a Cummins JF-110 (110 hp at 2200 rpm).

TO Salton Paving Co., Salton City, Calif., a Michigan Payloader model 275-H with Cummins NTO diesel (262 hp at 2100 rpm).

DELIVERED: a Caterpillar D342 naturally aspirated diesel to Hutchinson Co., El Cerrito, Calif. The 170 hp at 1200 rpm engine repowers a Northwest 1½ yd. shovel.

D & L Transportation of Vernon, Calif., has repowered a GMC truck with a Cummins C-160 stop-go engine (160 hp at 2100 rpm).

DIESEL pipeline trenchers are literally plowing a scientific furrow: the 8 ft. deep, 300 mi. pipe trench for final link of the 36 in. Pacific Gas & Electric Co. natural gas line, bringing gas from Alberta, Canada. University of California soil scientists will follow trencher—examining California soils never before sampled.

TO Washington Fish & Oyster Co., Kodiak, Alaska, a Western Ford diesel to repower a small seiner. Sale: Pacific Fishing & Trading Co.

VINNELL Corp., Alhambra, Calif., for its La Victoria, Mexico, construction project, has taken delivery of two model MP-20 Murphy diesels (147 hp continuous at 1200 rpm), driving Palmer 100 kw generators. Sale by Industrial Engine Sales, Los Angeles.

TO Web Pump and Supply Co., Escondido, Calif., a Lister-Blackstone HA-2 (22 hp at 1800 rpm, air-cooled), to drive farm irrigation pump. Sale: Bolstad Sales & Service, San Pedro.

FOR the 46 ft. offshore cruiser *Papagayo*, owned by Ralph Baker, a Caterpillar "compact" D318 turbocharged engine (200 hp at 2000 rpm), driving a 34x28 in. prop through 3:1 reduction. Installation by Shepherd Marine, Whittier, Calif.

INSTALLED: in the 52 ft. cruiser *Chickadee*, owned by Donald C. Burnham, a "compact" Caterpillar D333 (270 hp at 2200 rpm) as main propulsion, driving 44x38 in. blade through 4.41:1 reduction.

EDWARD H. Halton, Portland, Oregon, has powered his new 48 ft. cruiser with a Caterpillar D333 main diesel (270 hp at 2200 rpm), 3:1 reduction with a 40x28 in. blade. For auxiliary, geared to main shaft, same boat has installed a Petter AV-1, 6 hp English-made diesel.

Lube Filter Bulletin

Comparisons of various filtering media and contaminant removal tests are shown in chart form in "How to enjoy more miles of effective filtration at less cost", a 4 page bulletin offered by Luber-finer, Inc. Cut-away views illustrate the patented filtering process. Also included is a description of Luber-finer filtering units and replacement packs. To obtain a copy, write Luber-finer, Inc., 2514 So. Grand Ave., Los Angeles 7, Calif. (ITS NEW)

Michigan-Ohio News

By **Jim Brown**

WAYNE Seaman of Oscoda, Mich. has repowered his 42-ft. fishing boat *JANICE-A* with a Cummins H-6-M marine engine rated at 160 hp at 1800 rpm. A Twin Disc model MG-165 with a 3-to-1 reduction gear was used in the installation. The engine was supplied by Cummins Diesel Michigan, Inc.

BROADMAN Valley Development Co. of Traverse City, recently took delivery of a Hough H-90 Payloader powered by a Cummins C-175 diesel engine. Sale was made by Wolverine Tractor and Equipment Company of Detroit and Grand Rapids.

CITY of Lansing has accepted delivery on an Austin-Western model 300 Pacer grader. The new grader has 4-wheel drive, is equipped with an International UD-14 diesel engine and was purchased from the R. G. Moeller Co. of Detroit.

TAWAS Sand and Gravel Company of Tawas, Mich. has accepted delivery on an Allis Chalmers model HD-6E tractor with hydraulic bulldozer blade. Also delivered to Tawas Sand and Gravel Co. was an Allis Chalmers model D diesel grader. Both units were supplied by Earle Equipment Co. of Detroit.

A Michigan model 85A (1¾ yd.) tractor-shovel powered by a GM 4-53 diesel engine was recently sold to J. A. Fredman Co. of Pontiac, Michigan. Miller Equipment Co. of Livonia is the local distributor of Michigan equipment.

A Delmag HD-13 diesel pile-driving hammer with a capacity of 22,500 foot/pounds was recently sold to Industrial Brown Hoist Co. of Bay City, Michigan. The unit was sold by Cyril J. Burke Inc. of Detroit.

GORDON White of Rochester, Michigan recently installed a Cummins model NHRS-6-B (320 hp) in a model DC 9564 Autocar. The engine was supplied by Cummins Diesel Michigan, Inc.

AN International Harvester TD-9 diesel tractor was recently delivered to Robert Shourd of Flint, Mich. by Wolverine Tractor and Equipment Co. This TD-9 will be used in general excavation work.

CONSUMERS Power Co. has accepted delivery on a model HD6E Allis Chalmers diesel tractor. The tractor will be used on a pipeline operation near Williamston, Mich. and was purchased from Earle Equipment Co.

FOUR model 280 Michigan tractor-shovels powered by GM 8V-71 diesel engines were recently sold to the Holloway Construction Co. of Livonia, Mich. Two of the new 280's will be used on the relocation of US-12 near Bridgeman, Mich. and two will be broken in at Grayling, Mich. on Interstate 75. The sale was made by Miller Equipment Co.

A Bros SP-730 rubber-tired 30-ton roller powered by a Cummins model JN-6 (130 hp) with torque converter was recently sold to the Saginaw Asphalt Paving Co. The new Bros with its 1300x24 tires will be used for compaction of sub-base and asphalt roads. Sale was made by Cyril J. Burke, Inc.

CUMMINS Diesel Michigan, Inc. recently installed a C-160-B (160 hp) engine in a Ford model F-900 for Ira Wilson Dairy Co. of Detroit.

WOOLF Excavating Company of Kalamazoo, Mich. recently purchased an International TD-9 diesel tractor from Wolverine Tractor and Equipment Co.

THE City of Saginaw, Mich. has accepted delivery on an Austin-Western Pacer "100" with 4-wheel drive and powered by a GM 3-71 with torque converter. Sale was made by R. G. Moeller Co.

EARLE Equipment Co. sold an Allis-Chalmers model HD21 tractor with hydraulic bulldozer to Willard Searles of St. John, Mich. The new tractor will be broken in on a state highway project at Big Rapids, Mich.

MILLER Equipment Co. has sold a Huber-Warco Model 10D road grader powered by a GM 4-71 diesel to Ogemaw county road commission of West Branch, Mich.

TOM Sinacola of Livonia has accepted delivery on a Jaeger model 365 air compressor powered by a GM 4-71 diesel engine. Sale was made by Cyril J. Burke, Inc.

TERMINAL Steel & Equipment Corp. of Detroit ordered a Cummins H-6-1 (160 hp at 1800 rpm) for repowering their model 825G American Locomotive Crane. Engine supplied by Cummins Diesel Michigan, Inc.

ADVERTISERS' INDEX

Over-the-road fleet saves three cents per mile with RPM DELO Oil

OK Motor Service Inc. reduced their operating costs for its fleet of 24 highway tractors to only 9½¢ per mile—3 cents per mile less than average for trucking firms in the Chicago area. The reason: RPM DELO Lubricating Oil has extended engine life by 50 to 100% . . . lowered oil consumption and total operating costs.

"We've tried other products," reports Shop Superintendent A. T. Cosentino, ". . . but maintenance records prove RPM DELO Oil gives outstanding performance at the lowest cost per mile.

"Our fleet now averages better than 350,000 miles between overhauls. The life of fuel injection pumps has increased 500% and oil consumption has been reduced from 5.4 to 2.1 qts. per thousand miles. These results add up to real savings."

This inter-state trucking firm operates in Illinois, Wisconsin, and Indiana on a 24-hour day, six days a week. Their Diamond-T and Mack tractors average 110,000 miles per year.

RPM DELO Oil reduces wear and prolongs engine life because it clings to parts whether the engine is running or idle . . . hot or cold. Piston rings stay free because an anti-oxidant fights gum and lacquer formation and a special detergent keeps parts clean. Other additives prevent corrosion of bearing metal and crankcase foaming.

Why not try RPM DELO Oil? Chances are it can cut your costs, lengthen equipment life. Just call your local representative or write any company listed below:

RPM DELO

STANDARD OIL COMPANY OF CALIFORNIA, San Francisco 20 • **STANDARD OIL COMPANY OF TEXAS,** El Paso
CALIFORNIA OIL COMPANY, Perth Amboy, New Jersey - Denver, Colorado

R. H. Hertzberg, *Marine Supt., Cargo Carriers, Inc. (right) and R. B. Scott, Manager, Minneapolis Office, The Cooper-Bessemer Corporation discuss . . .*

How to move more ton-miles per horsepower

The Cooper-Bessemer-powered towboat Carcrosse has the answer. This 2400 hp boat of Cargo Carriers, Inc. has been setting records in the lower Mississippi, pushing more ton miles of cargo than any other boat her size. And, she is getting more ton-miles per horsepower installed.

The Carcrosse, shown here pushing 25,000 tons of grain, has been in almost uninterrupted service for 18 months, including ice breaking in winter months. She is equipped with two Cooper-Bessemer JS-8-T engines, each rated 1200 hp.

Check Cooper-Bessemer on how to assure top engine performance for the vessels *you* plan.

Cooper Bessemer

GENERAL OFFICES: MOUNT VERNON, OHIO

ENGINES: GAS - DIESEL - GAS-DIESEL
COMPRESSORS: RECIPROCATING AND CENTRIFUGAL
ENGINE, TURBINE OR MOTOR DRIVEN